INSTRUCTION MANUAL
OSCILLOSCOPE
COS5020
MODEL COS5021

1998

KIKUSUI
ELECTRONICS CORP.

TABLE OF CONTENTS

PAGE

1. GENERAL

1.1 Description

Kikusui Model COS5020/5021 Oscilloscope is a dual-channel oscilloscope with frequency bandwidth DC - 20 MHz (-3 dB), maximum sensitivity 1 mV/DIV, and maximum sweep time 20 nsec/DIV. Model 5021 has a sweep magnification feature with B sweep. The oscilloscope employs a 6-inch rectangular type cathode-ray tube with red internal graticule.

The oscilloscope is sturdy, easy to operate, and exhibits a high operation reliability. It is incorporated with the various convenient features and excellent functions, making itself an ideal instrument for diversified types of research and development work of electronic devices and equipment it can also be efficiently used for production lines and for maintenance and service.

1.2 Features

(1) Compact, light, but sturdy:

The oscilloscope is made of aluminium diecast and it is compact, light, but sturdy.

(2) Excellent operability:

Light torque types of lever switches and pushbutton switches are used. These and other controls are laid out in the most rational locations taking purposes and frequencies of their uses into consideration, thereby attaining an excellent operability.

(3) High intensity CRT with high acceleration voltage:

The CRT is a high beam transmission, high intensity type with a high acceleration voltage of 2.2 kV. It displays clearly readable traces even at high sweep speeds.

(4) High stability with less drift:

The oscilloscope employs a newly-developed temperature compensation circuit, thereby greatly reducing drift of base lines and DC balance distrubance caused by temperature change.

(5) A trigger level lock function which makes triggering adjustment procedure unnecessary:

A new trigger level lock circuit is incorporated. This circuit eliminates the requirement of troublesome triggering adjustment procedure not only for display of regular signals but also for that of video signals and large duty cycle ratio signals.

(6) TV sync triggering:

The oscilloscope has a sync separator circuit and triggering for TV V signal and TV H signal can be automatically switched being linked to the TIME/DIV switch.

(7) Linear focus:

Once the beam focus is adjusted to the optimum position, it is automatically maintained irrespective of intensity change, even for such waveforms with brightness variation as those displayed in the A INTEN mode.

2. SPECIFICATIONS

Vertical axes

Item	Specification	Remarks
Sensitivity	NORM: 5 mV - 5 V/DIV ×5 MAG: 1 mV - 1 V/DIV	1-2-5 sequence, 10 ranges
Sensitivity accuracy	NORM: ±3% or better ×5 MAG: ±5% or better	10 to 35°C (50 to 95°F), 1 kHz, at 4 or 5 DIV
Vernier vertical sensitivity	To 1/2.5 or less of panel-indicated value	
Frequency bandwidth	NORM: DC - 20 MHz, within -3 dB ×5 MAG: DC - 15 MHz, within -3 dB AC coupling: Low limit frequency 10 Hz	With reference to 50 kHz, 8 DIV
Rise time	NORM: Approx. 17.5 nsec ×5 MAG: Approx. 23 nsec	
Input impedance	1 MΩ ±2%, 25 pF ±2 pF	
Square wave characteristics	Overshoot: Not greater than 3% Other distortions: Not greater than 2% (At 10 mV/DIV range)	Other ranges: 3% added to the left values. 10 to 35°C (50 to 95°F)
DC balance shift	NORM: ±0.5 DIV ×5 MAG: ±2.0 DIV	
Linearity	±0.1 DIV or less of amplitude change when waveform of 2 DIV at graticule center is moved vertically.	
Display modes	CH1: CH1 single channel CH2: CH2 single channel DUAL: CHOP: 0.5 sec - 1 msec/DIV ALT: 0.5 msec - 0.2 µsec/DIV	When CH1 POSITION knob is pulled out (CHOP ONLY position), the two traces are displayed in the CHOP mode at all ranges.

Item	Specification		Remarks
	ADD:	CH1 + CH2 algebraic addition	
Chopping repetition frequency	Approx. 250 kHz		
Input coupling	AC/GND/DC		
Maximum allowable input voltage	400 V (DC + AC peak)		AC: 1 kHz or lower
Common mode rejection ratio	50:1 or better at 50 kHz, sinusoidal wave		When sensitivities of CH1 and CH2 are set equal
Isolation between channels	At least 1000:1 at 50 kHz At least 30:1 at 20 MHz		At 5 mV/DIV range
CH1 signal output	Approx. 100 mV/DIV when open; approx. 50 mV/DIV when 50-ohm termination		
CH2 INV BAL	Balanced point variation, 1 DIV or less		PULL CH2 POSITION (Reference at center graticule)

Triggering

Item	Specification	Remarks
Triggering source	CH1, CH2, LINE, and EXT (CH1 and CH2 can be selected only when the vertical mode is DUAL or ADD. In other cases, triggering source is automatically selected by the VERT MODE switch.)	
Coupling	AC, HF REJ, TV, DC	
Polarity	+ or -	

Item	Specification	Remarks
Sensitivity	DC - 10 MHz: 0.5 DIV (0.1 V) DC - 20 MHz: 1.5 DIV (0.2 V) Video signal: 2.0 DIV (0.2 V) AC coupling: Attenuate signal components of lower than 10 Hz HF REJ: Attenuate signal components of higher than 50 kHz	The values enclosed in the parentheses are the input sensitivities when in the EXT triggering mode.
Triggering modes	AUTO: Sweeps run in the free mode when no triggering input signal is applied.	Satisfies the sensitivity specification for signal repetition frequency of 50 Hz or over.
	NORM: When no triggering signal is applied, the trace is in the READY state and not displayed. SINGLE: One-shot sweep with triggering signal. Can be reset to the READY state by means of RESET switch. The READY lamp (LED) turns on when in the READY state or in the sweep operation.	
LEVEL LOCK	Satisfies the value of the above trigger sensitivity plus 0.5 DIV (0.05 V) for signal of duty cycle 20:80 and repetition frequency 50 Hz - 20 MHz.	
EXT triggering signal input	EXT HOR input terminal is used in common.	
Input impedance	1 MΩ ±2%, approx. 25 pF	
Maximum allowable input voltage	100 V (DC + AC peak)	AC frequency not highter than 1 kHz
B triggering signal	The A triggering signal of main sweep is used as the B triggering signal.	Model COS5021 only

Horizontal axis

Item	Specification	Remarks
Horizontal axis display	A, A INT, B, B TRIG'D	COS5021 only
A sweep (main sweep)		
Sweep time	0.2 µsec - 0.5 sec/DIV	1-2-5 sequence, 20 ranges
Sweep time accuracy	±3%	10 to 35°C (50 to 95°F)
Vernier sweep time control	To 1/2.5 or slower of panel-indicated value	
Holdoff time	Continuously variable to 2 times or over of sweep length (time) at 0.2 µsec/DIV - 1 msec/DIV ranges	
B sweep		COS5021 only. Triggered by A triggering signal
Delay system	Continuous delay and triggered delay	
Sweep time	NORM: 0.2 µsec/DIV - 0.5 msec/DIV ×10 MAG: 20 nsec/DIV - 50 µsec/DIV	
Sweep time accuracy	NORM: ±3%	10 to 30°C (50 to 95°F)
Delay time	2 µsec - 5 sec/DIV	
Delay time accuracy	±4% of the value read on CRT	
Delay jitter	1/10,000 or less $\frac{\text{B sweep time}}{\text{A sweep time}} \times \frac{\text{jitter width}}{\text{10 DIV}}$	Jitter width 0.5 DIV or less at A: 1 msec/DIV B: 1 µsec/DIV
Sweep magnification	10 times (maximum sweep time 20 nsec/DIV)	
Magnified sweep time accuracy	0.1 µsec/DIV - 0.5 sec/DIV ranges: ±5% 0.2 µsec/DIV - 0.5 µsec/DIV ranges: ±8%	10 to 35°C (50 to 95°F)
Linearity	NORM: ±3% ×10 MAG: ±5% (±8% for 0.2 µsec and 0.5 µsec/DIV	

Item	Specification	Remarks
Position shift caused by sweep magnification	Within 1 DIV at CRT screen center	
X-Y mode	X-axis: CH1 input signal Y-axis: CH2 input signal	
Sensitivity	Same as CH1 vertical axis	
Sensitivity accuracy	NORM: ±4% ×5 MAG: ±6%	10 to 35°C (50 to 95°F), 1 kHz, at 4 or 5 DIV
Frequency bandwidth	DC - 1 MHz (-3 dB)	
X-Y phase difference	Not greater than 3° at DC - 50 kHz	
EXT HOR mode	Trace swept by an external horizontal signal applied to the EXT TRIG IN terminal. Vertical axis modes are CH1, CH2, DUAL and ADD modes in the CHOP mode.	
Sensitivity	Approx. 0.1 V/DIV	
Frequency bandwidth	DC - 1 MHz (-3 dB)	
Phase difference between vertical axis	Within 3° (at DC - 50 kHz)	

Z axis

Item	Specification	Remarks
Sensitivity	3 Vp-p (Trace becomes brighter with negative input.)	
Frequency bandwidth	DC - 5 MHz	
Input resistance	Approx. 5 kΩ	
Allowable input voltage	50 V (DC + AC peak)	AC frequency not higher than 1 kHz

Calibration voltage

Item	Specification	Remarks
Waveform	Positive-going square wave	
Frequency	1 kHz ±20%	
Duty ratio	Within 45:55	
Output voltage	2 Vp-p, ±2%	
Output resistance	Approx. 2 kΩ	

CRT

Item	Specification	Remarks
Type	6-inch rectangular type, internal graticule	
Phosphor	P31	
Acceleration voltage	Approx. 2.2 kV	
Effective screen size	8 × 10 DIV	1 DIV = 10 mm (0.39 in.)
Graticule	Internal graticule; continuously adjustable illumination	

Line power requirements

Voltage: 100 V, 115 V, 215 V, 230 V; with ±10% allowance.
Selectable by connector change

Frequency: 50 Hz or 60 Hz

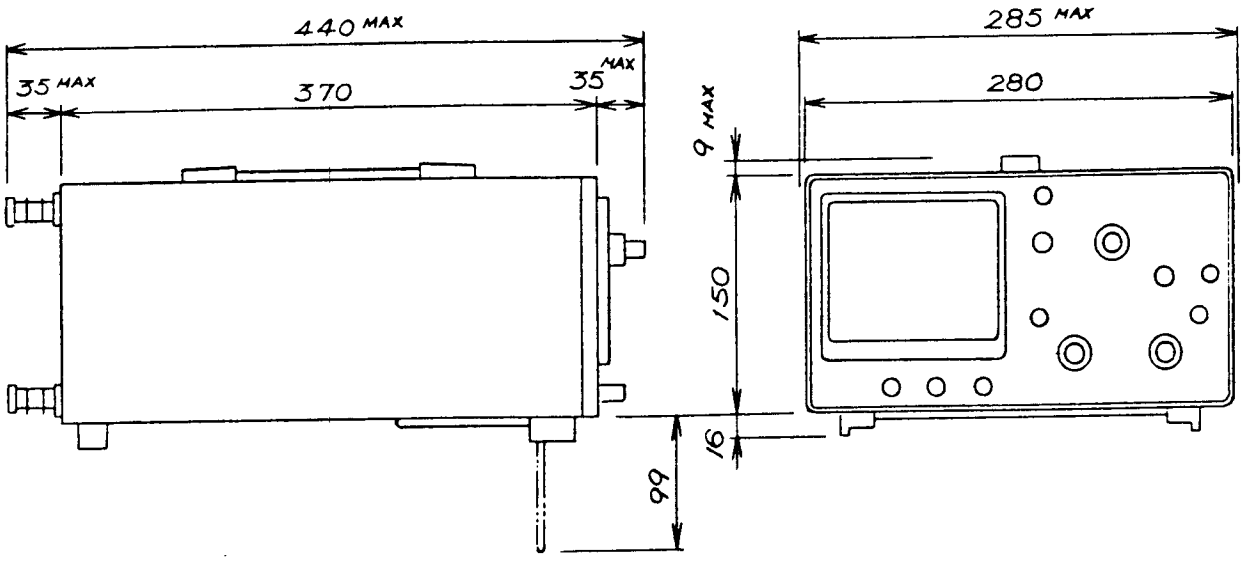
Power consumption: Approx. 35 VA

Mechanical specifications

Mainframe dimensions: 280 W × 150 H × 370 D mm
(11.02 W × 5.91 H × 14.57 D in.)

Maximum dimensions: 285 W × 175 H × 440 D mm
(11.22 W × 6.89 H × 17.32 D in.)

Weight: Approx. 7.0 kg (15.4 lbs)



Operating environment

To satisfy specifications: 5 to 35°C (41 to 95°F), 85% RH

Maximum operating ranges: 0 to 40°C (32 to 104°F), 90% RH

Accessories

P060-S probes (10:1, 1:1. 1.5 m) ...	(89-03-0300)	2
942A terminal adaptors	(W4-986-011)	2
Power cord		1
Instruction manual		1

o Specifications and contents on this manual are subject to change without notice.

3. PRECAUTIONS BEFORE OPERATING THE OSCILLOSCOPE

3.1 Unpacking the Oscilloscope

The oscilloscope is shipped from the factory after being fully inspected and tested. Upon receipt of the instrument, immediately unpack and inspect it for any damage which might have been sustained when in transportation. If any sign of damage is found, immediately notify the bearer and/or the dealer.

3.2 Checking the Line Voltage

The oscilloscope can operate on any one of the line voltages shown in the below table, by inserting the line voltage selector plug in the corresponding position on the rear panel. Before connecting the power plug to an AC line outlet, be sure to check that the voltage selector plug is set in the correct position corresponding to the line voltage. Note the oscilloscope may not properly operate or may be damaged if it is connected to a wrong voltage AC line.

When line voltages are changed, replace fuses also as required.

Selector plug position	Nominal voltage	Voltage tolerance	Fuse
A	100 V	90 - 110 V	0.5 A
B	115 V	104 - 126 V	
C	215 V	194 - 236 V	0.3 A
D	230 V	207 - 253 V	

3.3 Environments

The normal ambient temperature range of this instrument is 0 to 40°C (32 to 104°F). Operation of the instrument outside of this temperature range may cause damage to the circuits.

Do not use the instrument in a place where strong magnetic or electric field exists. Such fields may disturb the measurement.

3.4 CRT Intensity

In order to prevent permanent damage to the CRT phosphor, do not make the CRT trace excessively bright or leave the spot stationary for an unreasonably long time.

3.5 Withstanding Voltages of Input Terminals

The withstanding voltages of the instrument input terminals and probe input terminals are as shown in the following table. Do not apply voltages higher than these limits.

Input terminal	Maximum allowable input voltage
CH1, CH2, inputs	400 V (DC + AC peak)
EXT TRIG input	100 V (DC + AC peak)
Probe inputs	600 V (DC + AC peak)
Z AXIS input	50 V (DC + AC peak)

Note: AC frequency not higher than 1 kHz.

4. OPERATION METHOD

4.1 Explanation of Front Panel (See Figures 4-1 and 4-2.)

o CRT circuits:

POWER ..... ③ Main power switch of the instrument. When this switch is turned on, the LED ② above the switch is also turned on.

INTEN ..... ④ Controls the brightness of the spot or trace

B INTEN ..... ⑤ Semi-fixed potentiometer for adjusting trace intensity when in B sweep mode.
(COS5021 only)

FOCUS ..... ⑥ For focusing the trace to the sharpest image.

ILLUM ..... ⑧ Graticule illumination adjustment.

TRACE ROTATION .... ⑦ Semi-fixed potentiometer for aligning the horizontal trace in parallel with graticule lines.

Bezel ..... ㉟ For installing a camera mount in one-touch operation.

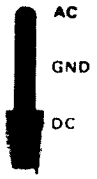
Filter ..... ㊱ Blue filter for ease of waveform viewing. Can be removed in one-touch operation.

o Vertical axis:

CH1 (X) input ..... ⑪ Vertical input terminal of CH1. During X-Y operation, this becomes X-axis (abscissa) input terminal.

CH2 (Y) input ..... (18) Vertical input terminal of CH2. During X-Y operation, this becomes Y-axis (ordinate) input terminal.

AC-GND-DC ..... (10)(19) Switch for selecting connection mode between input signal and vertical amplifier.



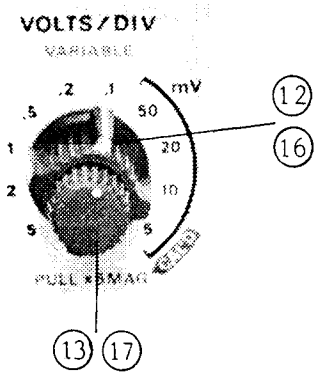
AC: AC coupling

GND: Vertical amplifier input is grounded and input terminals are disconnected.

DC: DC coupling

VOLTS/DIV ..... (12)(16) Select the vertical axis sensitivity, from 5 mV/DIV to 5 V/DIV with 10 ranges.

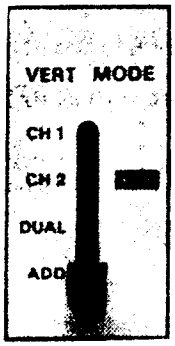
VARIABLE ..... (13)(17) Fine adjustment of sensitivity, with a factor of 1/2.5 or higher of the panel-indicated value. At the CAL'D position, sensitivity is calibrated to the panel-indicated value. When this knob is pulled out (x5 MAG state), the amplifier sensitivity is multiplied by 5 times.



POSITION ..... (9)(20) Vertical positioning control of trace or spot.

VERT MODE ..... (14) Selects operation modes of CH1 and CH2 amplifiers. Also selects internal triggering source signal.

CH1: The oscilloscope operates as a single-channel instrument with CH1 alone. The CH1 input signal is used as the internal triggering source signal.



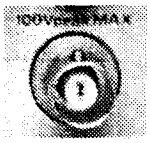
CH2: The oscilloscope operates as a single-channel instrument with CH2 alone. The CH2 signal is used as the internal triggering source signal.

DUAL: The oscilloscope operates as a dual-channel instrument with both CH1 and CH2. The internal triggering source signal is selected by SOURCE switch (26).

ADD: The oscilloscope displays the algebraic sum (CH1 + CH2) or difference (CH1 - CH2) of the two signals. The pulled out state of CH2 POSITION knob (20) provides the difference (CH1 - CH2). The internal triggering source signal is selected by SOURCE switch (26).

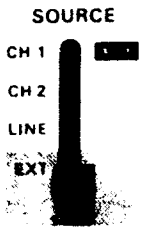
o Triggering

EXT TRIG (EXT HOR) .. (23) input terminal



This terminal is used in common for external triggering signal and external horizontal signal. To use this terminal, set SOURCE switch (26) to the EXT position.

SOURCE ..... (26)



Selects the internal triggering source signal. Also select the EXT HOR input signal.

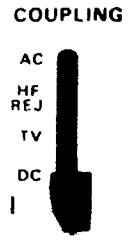
CH1 X-Y : When the VERT mode switch (14) is set at the DUAL or ADD position, selects CH1 for the internal triggering source signal. During the X-Y mode operation, selects CH1 for the X-axis signal.

CH2: When the VERT mode switch (14) is set at the DUAL or ADD position, selects CH2 for the internal triggering source signal.

EXT: The external signal applied through EXT TRIG (EXT HOR) input terminal (23) is used for the external triggering source signal. During the X-Y, EXT HOR mode operation, the X-axis operates with the external sweep signal.

Note: When the VERT MODE switch is set to the CH1 or CH2 position, internal triggering source signal selection cannot be made by the SOURCE signal. In such cases, a triggering source signal is set by the VERT MODE switch.

COUPLING ..... (25) Select coupling mode between triggering source signal and trigger circuit; select connection of TV sync trigger circuit.



AC: AC coupling

HF REJ: AC coupling, with components higher than 50 kHz rejected.

DC: DC coupling

TV: The trigger circuit is connected to the TV sync separator circuit and the sweeps are synchronized with the TV V or TV H signal at a rate selected by the TIME/DIV switch (30).

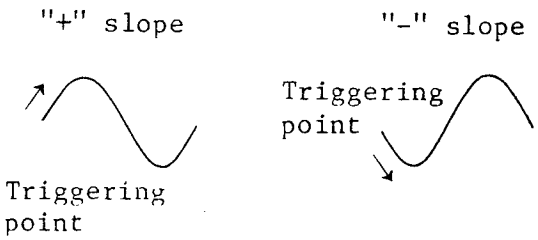
TV V: 0.5 sec/DIV - 0.1 msec/DIV.

TV H: 50 µsec/DIV - 0.2 µsec/DIV.

SLOPE ..... (24) Selects the triggering slope.

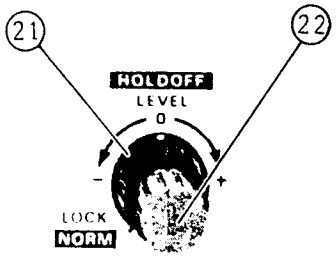
"+": Triggering occurs when the triggering signal crosses the triggering level in the direction of signal increase (i. e., positive direction).

"-": Triggering occurs when the triggering signal crosses the triggering level in the direction of signal decrease (i. e., negative direction).



HOLDOFF ..... (21)
LEVEL ..... (22)

These double-knob controls are for holdoff time adjustment and triggering level adjustment.



The HOLDOFF time control is used when the signal waveform is complex so that stable triggering cannot be attained with LEVEL knob (22) alone.

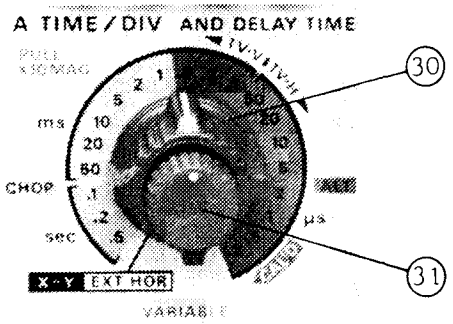
The LEVEL knob is for displaying a synchronized stationary waveform and setting a start point for the waveform.

As this knob is turned in "→ +" direction, the triggering level moves upward on the displayed waveform; as the knob is turned in " - ←", the triggering level moves downward.

When set at the LOCK position, the triggering level is automatically maintained at the optimum value irrespective of the signal amplitude (from very small amplitude to large amplitude), requiring no manual adjustment of triggering level.

o Time Base

A TIME/DIV AND ..... (30)
DELAY TIME
(COS5021 only)

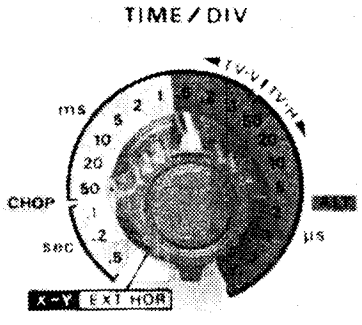


Selects the sweep time for the A sweep or the delay time when in the delayed sweep mode. When this switch is set to the X-Y EXT HOR position, the oscilloscope operates as an X-Y scope with CH1 for the X-axis or operates in the EXT HOR mode with an external sweep input signal for the horizontal signal.

(For details, see Page 28 and 29.)

TIME/DIV ..... (30)
(COS5020 only)

Selects the sweep time.



VARIABLE ..... (31)
PULL ×10 MAG

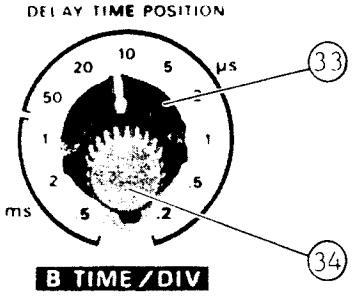
Vernier control of sweep time (the A sweep for COS5021). The sweep time can be made slower by a factor of 2.5 or more of the panel-indicated value.

The panel-indicated values are calibrated with this knob set in the CAL'D position.

The pulled out position of this knob is for the ×10 MAG state.

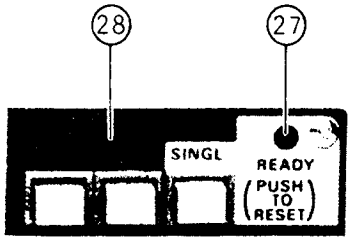
POSITION ..... (32) Vertical adjustment of the trace or spot.

B TIME/DIV ..... (33) Selects the sweep time for delayed sweep (B sweep).
(COS5021 only)



DELAY TIME POSITION.. (34) Vernier control of the delay time selected by the A TIME/DIV AND DELAY TIME switch (30), to finely select the portion of the A sweep waveform to be magnified.

SWEEP MODE ..... (28) Selects the desired sweep mode.



AUTO: When no triggering signal is applied or when triggering signal frequency is less than 50 Hz, sweep runs in the free run mode.

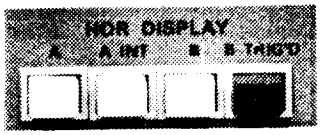
NORM: When no triggering signal is applied, sweep is in a ready state and the trace is blanked out. Used primarily for observation of signals of 50 Hz or lower.

SINGLE: PUSH TO RESET — Used for single sweep operation (one-shot sweep operation), and in common as the reset switch.

When the three buttons are in the pushed out state, the circuit is in the single sweep mode. The circuit is reset as this button is pressed. When the circuit is reset, the READY lamp (27) turns on. The lamp goes off when the single sweep operation is over.

HOR DISPLAY ..... (29) (COS5021 only)

Selects A and B sweep mode as follows:



A: Main sweep (A sweep) mode for general waveform observation.

A INT: This sweep mode is used when selecting the section to be magnified of the A sweep, in preparation for delayed sweep. The B sweep section (delayed sweep) corresponding to the A sweep is displayed with high brightness.

B: Displays the delayed sweep (B sweep) alone.

B TRIG'D: Selects between continuous delay and triggered delay.

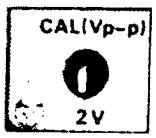
⊓: For continuous delay. The B sweep starts immediately after the sweep delay time set by DELAY TIME switch (30) and DELAY TIME POSITION knob (34) has elapsed.

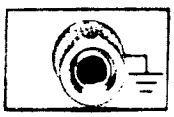
⊓: For triggered delay. The B sweep starts when the triggering pulse is applied after the sweep delay time set by DELAY TIME switch and DELAY TIME POSITION knob has elapsed.

(The triggering signal is used in common for both A sweep and B sweep.)

o Others

CAL (Vp-p) ..... (1) This terminal delivers the calibration voltage of 2 Vp-p, approximately 1 kHz, positive square wave. The output resistance is approximately 2 kΩ.





..... (15) Ground terminal of oscilloscope mainframe.

4.2 Explanation of Rear Panel

o Z AXIS INPUT ..... (37) Input terminals for external intensity modulation signal.

o CH1 SIGNAL OUTPUT ... (38) Delivers the CH1 signal with a voltage of approximately 100 mV per 1 DIV of graticule. When terminated with 50 ohms, the signal is attenuated to about a half. May be used for frequency counting, etc.

o AC Power Input Circuit

AC power input connector ... (40)

Input connector of the AC power of the instrument. Connect the AC power cord (supplied) to this connector.

FUSE ..... (41) Fuse in the primary circuit of the power transformer. Fuse rating is as shown in Table (44).

AC voltage selecting connector ... (42)

For selecting the AC voltage of the instrument.

AC voltage selector plug ... (43)

For selecting the AC voltage of the instrument by aligning its arrowhead mark in the corresponding position as shown in Table (44).

o Studs ..... (39) Studs for laying the oscilloscope on its back to operate it in the upward posture. Also used to take up the power cord.

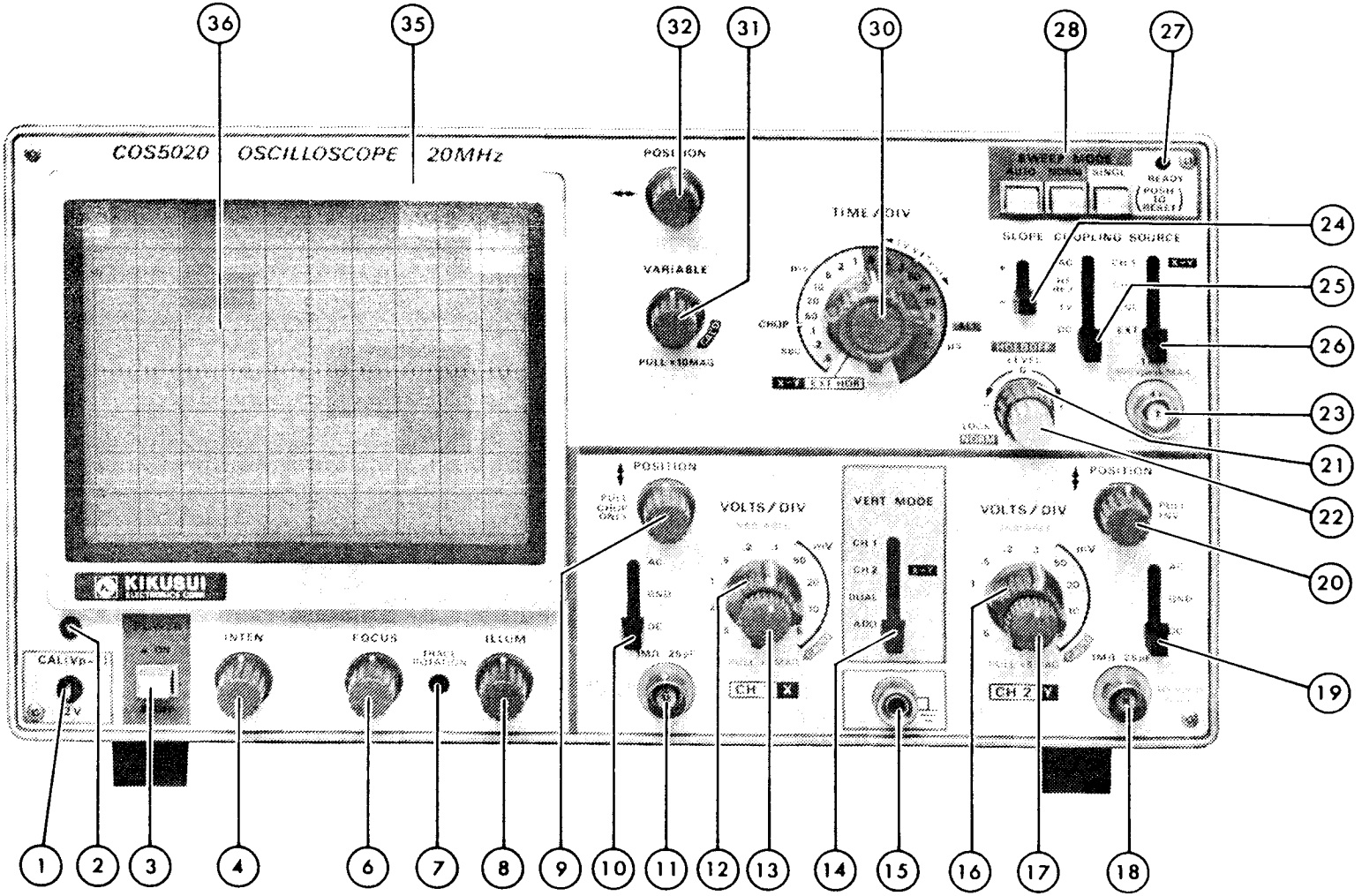


Figure 4-1 (Model COS5020)

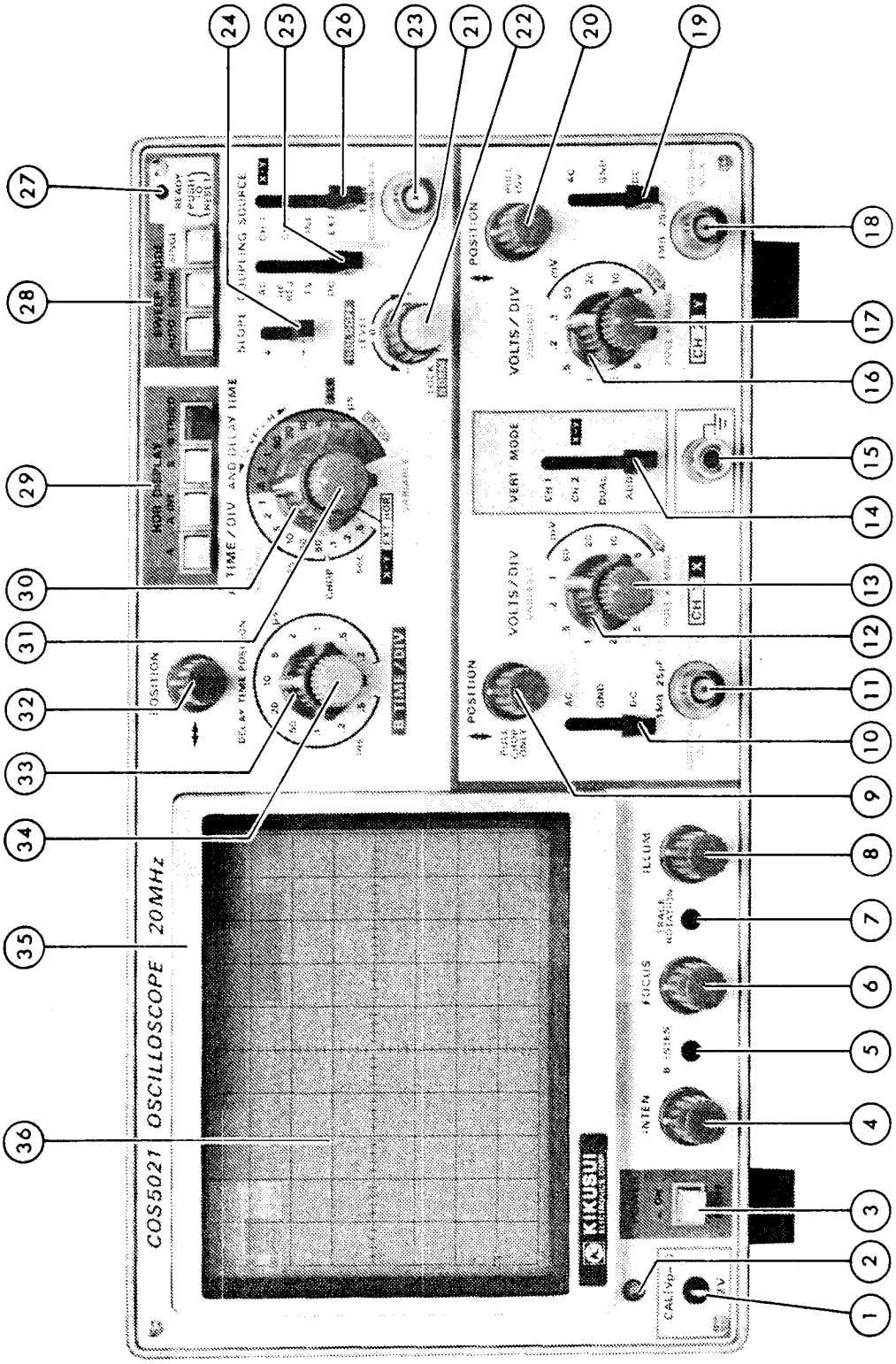


Figure 4-2 (Model COS5021)

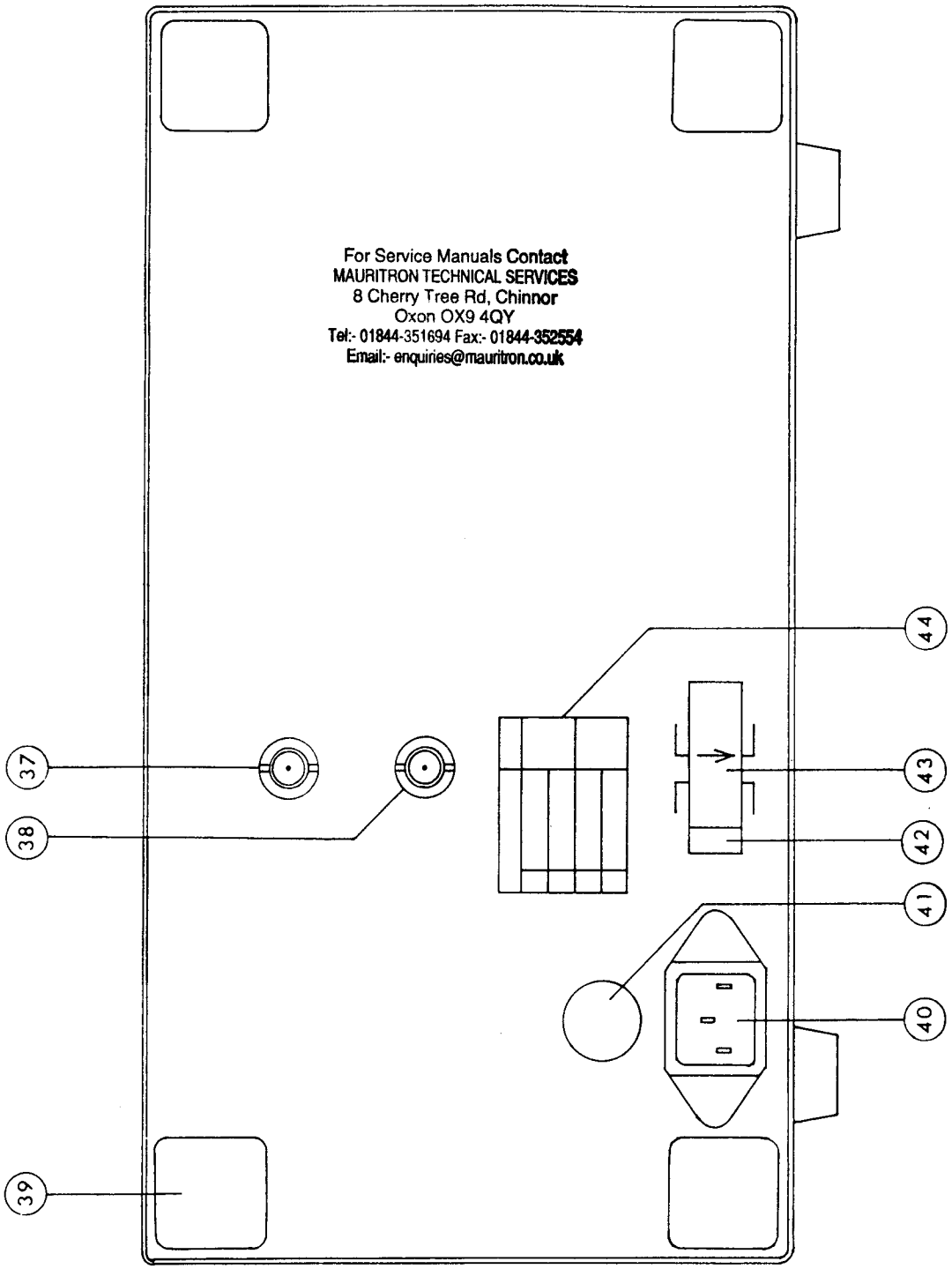

For Service Manuals Contact
MAURITRON TECHNICAL SERVICES
8 Cherry Tree Rd, Chinnor
Oxon OX9 4QY
Tel:- 01844-351694 Fax:- 01844-352554
Email:- enquiries@mauritron.co.uk
37
38
39
40
41
42
43
44

Figure 4-3

4.3 Basic Operation

Before connecting the power cord to an AC line outlet, check that the AC line voltage selector plug on the rear panel of the instrument is correctly set for the AC line voltage. After ensuring the voltage setting, set the switches and controls of the instrument as shown in the following table.

Item	No.	Setting
POWER	③	⎍ OFF position
INTEN	④	Clockwise (3-o'clock position)
FOCUS	⑥	Mid-position
ILLUM	⑧	Counterclockwise position
VERT MODE	⑭	CH1
↕ POSITION	⑨ ⑳	Mid-position, pushed in
VOLTS/DIV	⑫ ⑯	500 mV/DIV
VARIABLE	⑬ ⑰	CAL'D (clockwise position), pushed in
AC-GND-DC	⑩ ⑲	GND
SOURCE	㉖	Be selected automatically to CH1
COUPLING	㉕	AC
SLOPE	㉔	+
LEVEL	㉒	LOCK (counterclockwise)
HOLDOFF	㉑	NORM (counterclockwise)
SWEEP MODE	㉘	AUTO
HOR DISPLAY	㉙	A (COS5021 only)
TIME/DIV	㉚	0.5 msec/DIV
VARIABLE	㉛	CAL'D (clockwise), pushed in
↔ POSITION	㉜	Mid-position

After setting the switches and controls as indicated above, connect the power cord to the AC line outlet and, then, proceed as follows:

1) Turn-ON the POWER switch and make sure that the power pilot LED is turned on. In about 20 seconds, a trace will appear on the CRT screen. If no trace appears even after about 60 seconds, repeat the switch and control settings as shown in the above table.

2) Adjust the trace to an appropriate brightness and to the sharpest image with the INTEN control and FOCUS control.

3) Align the trace with the horizontal center line of graticule by adjusting the CH1 POSITION control and TRACE ROTATION control (screwdriver adjustment).

4) Connect the probe (supplied) to the CH1 INPUT terminal, and apply the 2 Vp-p CALIBRATOR signal to the probe tip.

5) Set the AC-GND-DC switch in the AC state. A waveform as shown in Figure 4-4 will be displayed on the CRT screen.

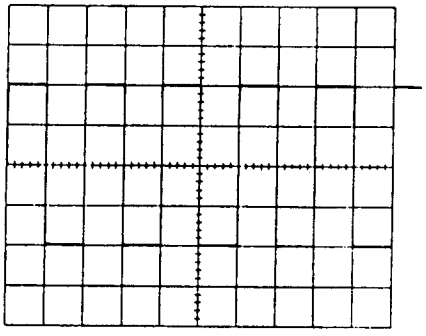


Figure 4-4

6) Adjust the FOCUS control until the sharpest trace image becomes available.

7) For signal viewing, adjust the VOLTS/DIV switch and TIME/DIV switch to appropriate positions so that the signal waveform is displayed with an appropriate amplitude and an appropriate number of peaks.

8) Adjust the ↕ POSITION and ↔ POSITION controls to appropriate positions so that the displayed waveform is aligned with the graticule and the voltage (Vp-p) and period (T) can be read as desired.

The above procedure is the basic operating procedure of the oscilloscope for single-channel operation with CH1. Single-channel operation with CH2 also can be made in a similar manner. Further operation methods are explained in the subsequent paragraphs.

4.4 Dual-channel Operation

Change the VERT MODE switch to the DUAL position so that the other trace (CH2) also is displayed. (The trace explained in the preceding section was for CH1.) At this state of procedure, the CH1 trace has the square wave of the calibration signal and the CH2 trace has a straight line since no signal is applied to this channel yet.

Now, apply the calibration signal also to the vertical input terminal of CH2 with the probe as was the case for CH1. Set the AC-GND-DC switch at the AC position. Adjust vertical POSITION knobs (9) and (20) so that two channels of signals are displayed as shown in Figure 4-5.

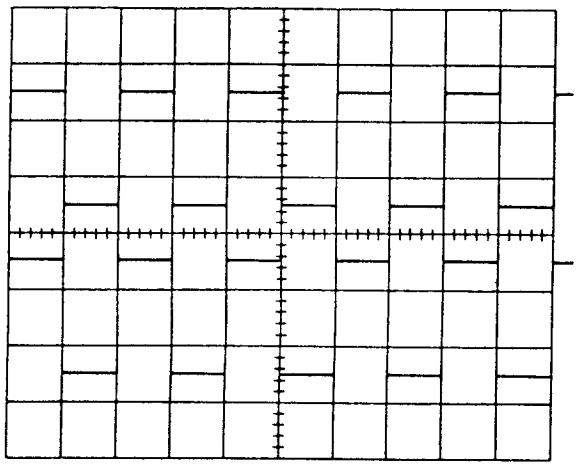
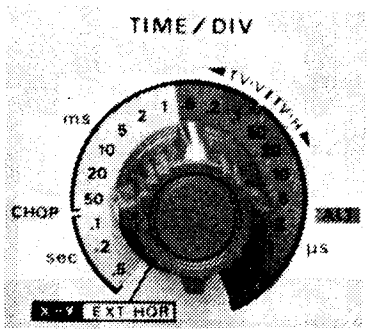


Figure 4-5

During the dual-channel operation (DUAL or ADD mode), either the CH1 or CH2 signal must be selected as the triggering source signal by means of the SOURCE switch. If both CH1 and CH2 signals are in a synchronized state, both waveforms can be displayed stationary; if not, only the signal selected by the SOURCE switch can be displayed stationary.

Selection between CHOP mode and ALT mode is automatically made by the TIME/DIV switch. The 1 msec/DIV and lower ranges are used with the CHOP operation and the 0.5 msec/DIV and higher ranges are used with the ALT operation.

Figure 4-6



When the ↕ POSITION knob is pulled out, the two traces are displayed with the CHOP operation over the entire ranges.

4.5 ADD Operation

An algebraic sum of the CH1 and CH2 signals can be displayed on the screen by setting the VERT MODE switch at the ADD position. The displayed signal becomes the difference between CH1 and CH2 signals if the CH2 POSITION knob is pulled out (PULL INV).

For accurate addition or subtraction, it is a prerequisite that the sensitivities of the two channels be adjusted accurately at the same value by means of the VARIABLE knobs. Vertical positioning can be made with the ↕ POSITION knob of either channel. In view of the linearities of the vertical amplifiers, it is most advantageous to set both knobs in their mid-positions.

4.6 X-Y Operation and EXT HOR Operation

When the TIME/DIV switch is set at the [X-Y] [EXT HOR] positon, the internal sweep circuit is disconnected and the trace in the horizontal direction is driven by the signal selected by the SOURCE switch. When the switch is set to the CH1 [X-Y] position, the oscilloscope operates as an X-Y scope with the CH1 signal for the X-axis; when it is set to the EXT position, the oscilloscope operates in the EXT HOR (external sweep) mode.

o X-Y operation

The X-Y mode is operated with the VERT MODE switch selected for CH2 [X-Y] and the TIME/DIV switch in the fully counter clockwise position. CH1 becomes the X axis while CH2 becomes the Y axis, whose position is controled by the horizontal position knob. The bandwidth of the X axis becomes DC to 1 MHz (-3 dB).

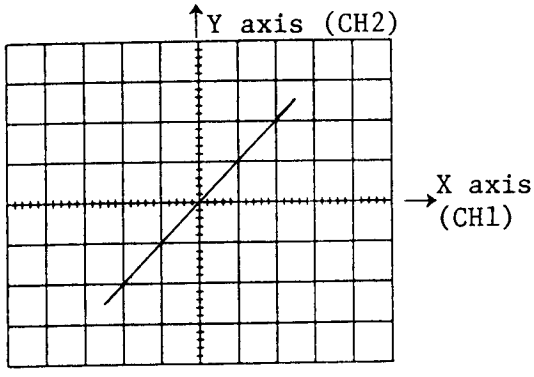


Figure 4-7

o EXT HOR (external sweep) operation

The external signal applied through the EXT HOR terminal (23) drives the X axis. The Y axis is controled with any channel or channels as selected by the VERT MODE switch. When the DUAL mode is selected by the switch, both CH1 and CH2 signals are displayed in the CHOP mode.

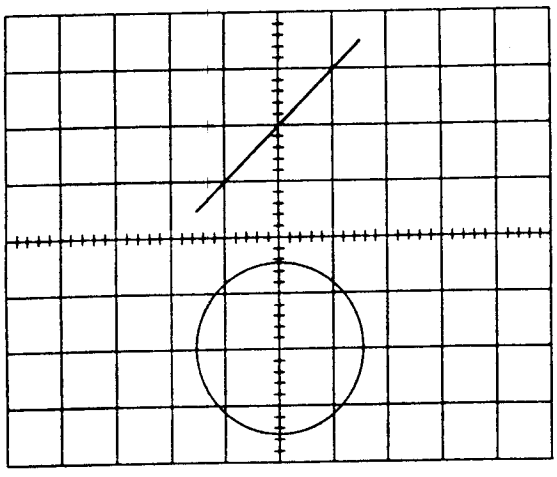


Figure 4-8. Dual-channel X-Y operation

4.7 Triggering

Proper triggering is essential for an efficient operation of the oscilloscope. The user of the oscilloscope must become thoroughly familiar with the triggering functions and procedures.

(1) Functions of SOURCE Switch:

To display a stationary pattern on the CRT screen, the displayed signal itself or a trigger signal which has a time relationship with the displayed signal is required to be applied to the trigger circuit. The SOURCE switch selects such a triggering source.

CH1: CH2: This internal trigger method is used most commonly. The signal applied to the vertical input terminal is branched off from the preamplifier and is fed to the trigger circuit through the VERT MODE switch. Since the triggering signal is the measured signal itself, a very stable waveform can be readily displayed on the CRT screen.

During the single-sweep mode opration, the signal of the channel selected by the VERT MODE switch is used as the triggering source signal.

During the DUAL or ADD operation, the signal selected by the SOURCE switch is used as the triggering source signal.

LINE: The AC power line frequency signal can also be used as the triggering signal. This mathod is effective when the measured signal has a close relationship with the AC line frequency, especially for measurements of low level AC noise of audio equipment, thyristor circuits, etc.

EXT: The sweep is triggered with an external signal applied to the external trigger input terminal. An external signal which has a periodic relationship with respect to the measured signal is used. Since the measured signal is not used as the triggering signal, waveform can be displayed more independently of the measured signal.

The above triggering source signal selection function are summarized in the following table.

VERT MODE / SOURCE	CH1	CH2	DUAL	ADD
CH1	Triggered by CH1 signal	Triggered by CH2 signal	Triggered by CH1 signal	
CH2			Triggered by CH2 signal	
LINE	Triggered by LINE signal			
EXT	Triggered by EXT TRIG input signal			

(2) Functions of COUPLING switch:

This switch is used to select the coupling of the triggering signal to the trigger circuit in accordance with the characteristics of the measured signal.

AC: This coupling is used for AC triggering which is used most commonly. As the triggering signal is applied to the trigger circuit through an AC coupling circuit, stable triggering can be attained without being affected by the DC component of the input signal. The low-range cut off frequency is 10 Hz (-3 dB).

When the ALT trigger mode is used and the sweep speed is slow, jitter may be produced. In such a case, use the DC mode.

HF REJ: The triggering signal is fed to the trigger circuit through an AC coupling circuit and a low pass filter (approximately 50 kHz, -3 dB). The higher components of the trigger signal are rejected through the low pass filter and the lower components alone of the trigger signal are applied to the trigger circuit.

TV: This conpling is used for TV triggering for observation of TV video signals. The triggering signal is AC-coupled and fed via the trigger circuit (level circuit) to the TV sync separator circuit. The separator circuit picks

off the sync signal, which is used to trigger the sweep. Thus, the video signal can be displayed very stably.

Being linked to the TIME/DIV switch, the sweep speed is switched for TV.V and TV.H as follows:

TV.V: 0.5 sec - 0.1 msec
TV.H: 50 μsec - 0.2 μsec

The SLOPE switch should be set in conformity with the video signal as shown in Figure 4-9.

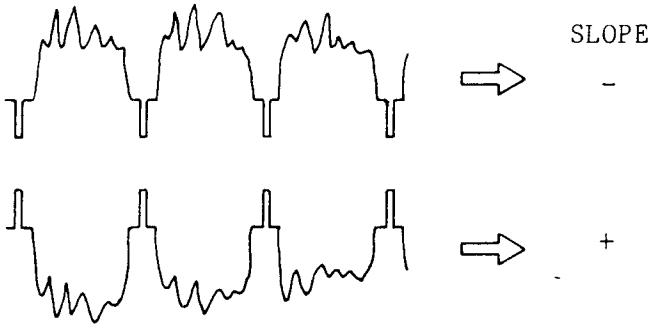


Figure 4-9

DC: The triggering signal is DC-coupled to the trigger circuit. This mode is used when triggering is desired with the DC component of the triggering signal or when a very low frequency signal or a signal of large duty cycle ratio is needed to be displayed.

(3) Functions of SLOPE switch:

This switch selects the slope (polarity) of the triggering signal.

"+": When set in the "+" state, triggering occurs as the triggering signal crosses the triggering level in the direction of signal increase (i.e, positive direction).

"-": When set in the "-" state, triggering occurs as the triggering signal crosses the triggering level in the direction of signal decrease (i.e, negative direction).

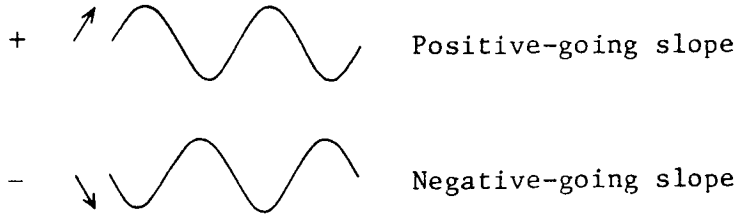


Figure 4-10

(4) Functions of LEVEL (LOCK) control:

The function of this control is to adjust the triggering level and display a stationary image. At the instant of the triggering signal crossing the triggering level set by this control, the sweep is triggered and a waveform is displayed on the screen.

The trigger level changes in the positive direction (upward) as this control knob is turned clockwise and it changes in the negative direction (downward) as the knob is turned counter-clockwise. The rate of change is set as shown in Figure 4-11.

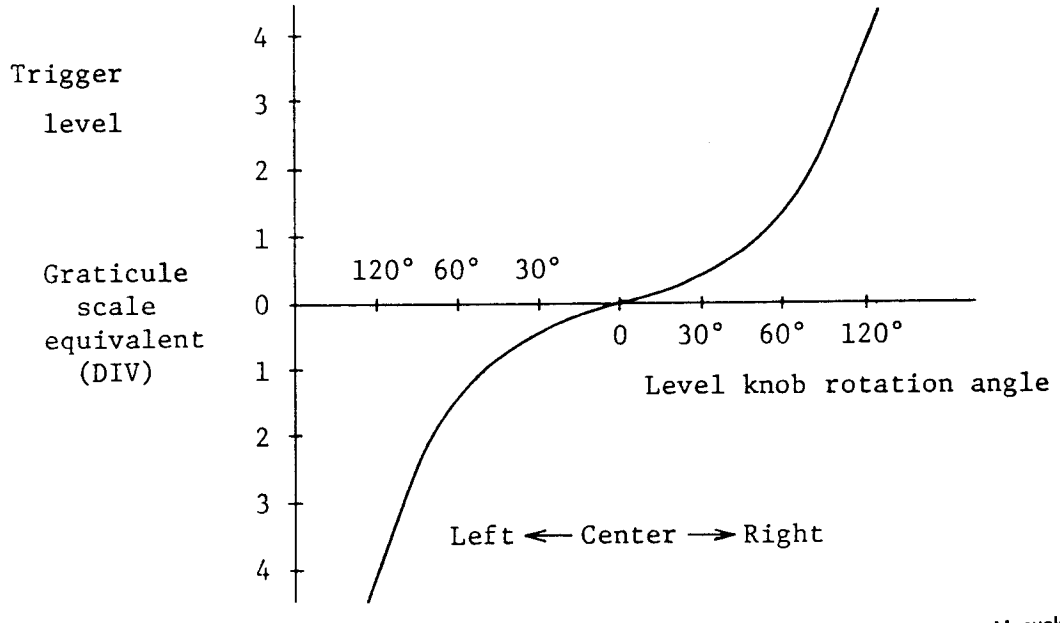


Figure 4-11

o LEVEL LOCK

When the LEVEL knob is set at the LEVEL LOCK position, the triggering level is automatically maintained within the amplitude of the triggering signal and stable triggering is made without requiring level adjustment (although jitter may not be suppressed during the ALT mode operation). This automatic level lock function is effective when the signal amplitude on the screen or the input voltage of the external triggering signal is within the following range:

50 Hz - 10 MHz: 1.0 DIV (0.15 V) or less
50 Hz - 20 MHz: 2.0 DIV (0.25 V) or less

(5) Functions of HOLD OFF control:

When the measured signal has a complex waveform with two or more repetition frequencies (periods), triggering with the above-mentioned LEVEL control alone may not be sufficient for attaining a stable waveform display. In such a case, the sweep can be stably synchronized to the measured signal waveform by adjusting the HOLD OFF time (sweep pause time) of the sweep waveform. The control covers at least the time of one full sweep, for sweeps faster than 0.2 sec/DIV.

Figure 4-11 (1) shows a case for HOLD OFF knob at the NORM position. Various different waveforms are overlapped on the screen, making the signal observation unsuccessful.

Figure 4-11 (2) shows a case in which the undesirable portion of the signal is held off. The same wavefotms are displayed on the screen without overlapping.

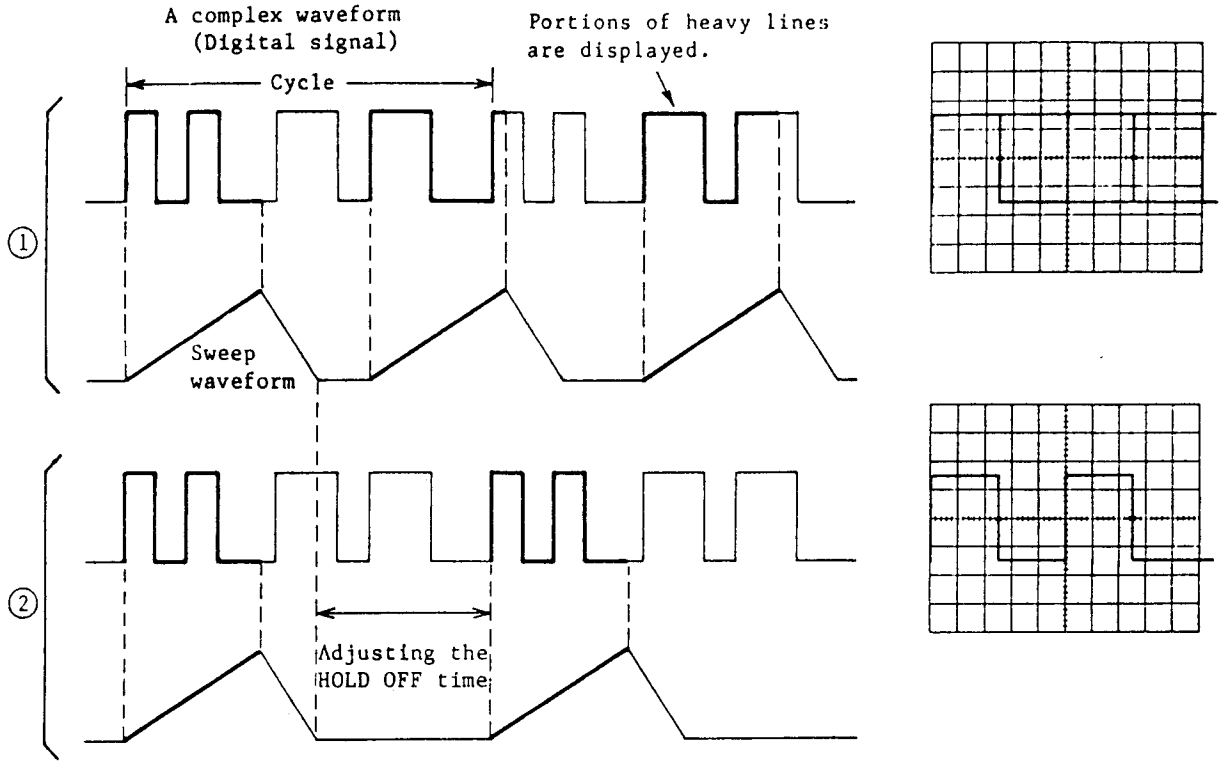


Figure 4-12

4.8 Single-sweep Operation

Non-repetitive signals and one-shot transiential signals can hardly be observed on the screen with the regular repetitive sweep operation. Such signals can be measured by displaying them in the single-sweep mode on the screen and photographing them.

o Measurement of non-repetitive signal:

(1) Set the SWEEP MODE at the NORM position.

(2) Apply the measured signal to the vertical input terminal and adjust the triggering level.

(3) Set the SWEEP MODE at the SINGLE position (the three pushbutton switches are pushed out).

(4) Press the RESET button. The sweep will run only for one cycle and measured signal will be displayed only once on the screen.

o Measurement of one-shot signal:

(1) Set the SWEEP MODE at the NORM position.

(2) Apply the calibration output signal to the vertical input terminal, and adjust the triggering level at a value corresponding to the predicted amplitude of the measured signal.

(3) Set the SWEEP MODE at the SINGLE position. Apply the measuted signal, instead of the calibration signal, to the vertical input terminal.

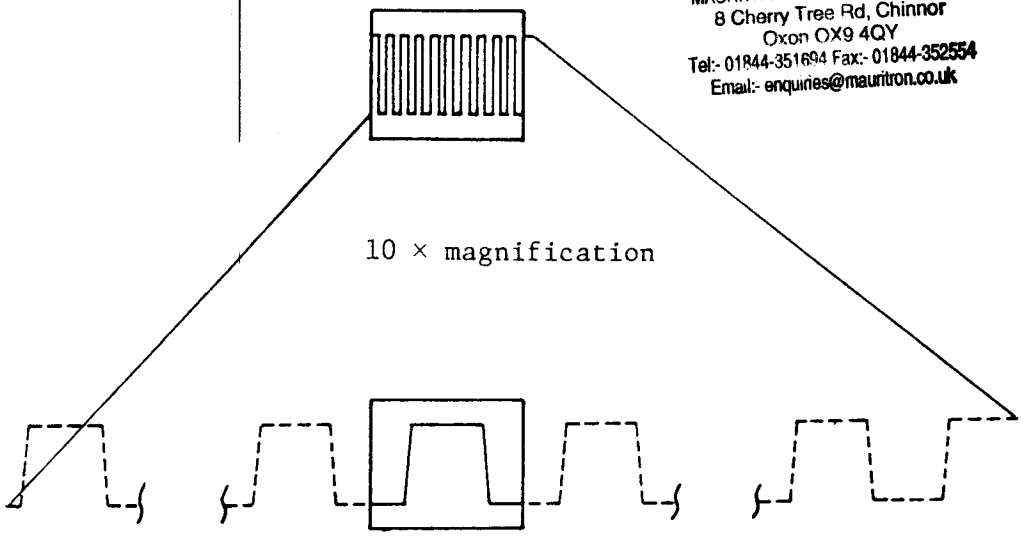
(4) Depress the RESET button. The sweep circuit will become in the ready state and the READY lamp will light on.

(5) As the one-shot signal occurs in the input circuit, the sweep runs only for one cycle and the one-shot signal is displayed on the CRT screen.

The single-sweep operation can be done also with A INTEN B sweep. However, it cannot be done in the dual-channel ALT mode operation. For dual-channel one-sweep operation, use the CHOP mode.

4.9 Sweep Magnification

When a certain position of the displayed waveform is needed to be expanded timewise, a faster sweep speed may be used. However, if the required portion is far away from the starting point of the sweep, the required portion may run off the CRT screen. In such a case, pull out (set in the x10 MAG state) the sweep VARIABLE KNOB (31) . When this is done, the displayed waveform is expanded by 10 times to right or left with the center of screen at the center of expansion.



Any portion can be covered by means of POSITION control.

Figure 4-13

The sweep time during the magnification operation is obtained as follows:

(Value indicated by TIME/DIV switch) × 1/10

Thus, the unmagnified maximum sweep speed (0.2 µsec/DIV) can be made faster with magnification as follows:

0.2 µsec/DIV × 1/10 = 20 nsec/DIV

When the sweep is magnified and the sweep speed has become faster than 0.2 µsec/DIV, the trace may become darker. In such a case, the displayed waveform should be expanded in the B sweep mode explained in the subsequent paragraphs (COS5021 only).

4.10 Waveform Magnification with Delayed Sweep (COS5021 only).

With sweep magnification of the preceding paragraph, although the magnification method is simple, the magnification ratio is limited at 10. With the delayed sweep method of this paragraph, on the other hand, the sweep can be expanded for a wide range from several times to several thousand times according to the ratio between A sweep time and B sweep time.

As the measured signal frequency becomes high and the A sweep range for the non-expanded signal becomes higher, the available expansion ratio becomes smaller. Furthermore, as the magnification ratio becomes larger, the trace intensity becomes lower and the delay jitter increases. To cope with these situations, a continuously-variable delay circuit and a triggered delay circuit are incorporated into the oscilloscope.

(1) Continuously-variably delay:

Set the HOR DISPLAY switch to A and display the signal waveform with the A sweep in the regular operation method.

Next, set the B TIME/DIV switch at a position faster by several steps than the A TIME/DIV switch.

After ensuring that the B TRIG'D button of the HOR DISPLAY switch is at the pushed out position (⊓), turn the HOR DISPLAY switch to the A INTEN position. A portion of the displayed waveform will be accentuated as shown in Figure 4-14, indicating the state ready for delayed sweep. The portion of the accentuated brightness indicates the section corresponding to the B sweep time (DELAYED SWEEP). This portion is expanded on the B sweep.

The period from the start of the A sweep to that of the B sweep (the period to the start of trace accentuation) is called "SEEP DELAY TIME." This period is continuously variable by means of the DELAY TIME POSITION knob.

Next, change the HOR DISPLAY switch to the B position. The B sweep time will be expanded for the full span of the CRT screen as shown in Figure 4-15.

The B sweep time is set by the B TIME/DIV switch and the magnification ratio becomes as follows:

$$\text{Magnification ratio} = \frac{\text{A TIME/DIV indication}}{\text{B TIME/DIV indication}}$$

The sweep delay time can be read on the CRT screen. For more accurate determination, the DELAY TIME MULTI dial should be used.

$$\text{Sweep delay time} = \begin{matrix}\text{A TIME/DIV} \\ \text{indication}\end{matrix} \times \begin{matrix}\text{DELAY TIME MULTI} \\ \text{dial setting}\end{matrix}$$

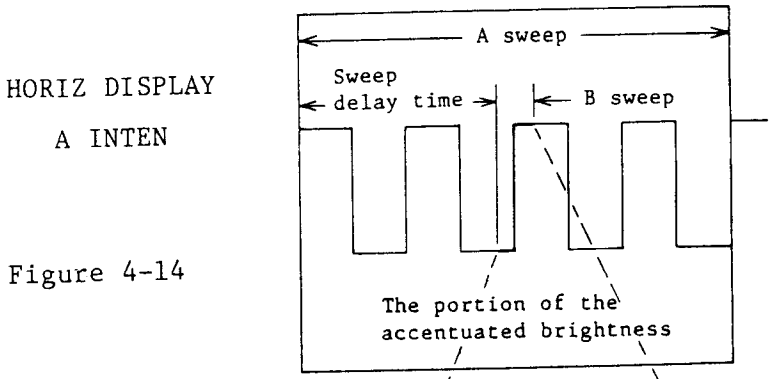


Figure 4-14

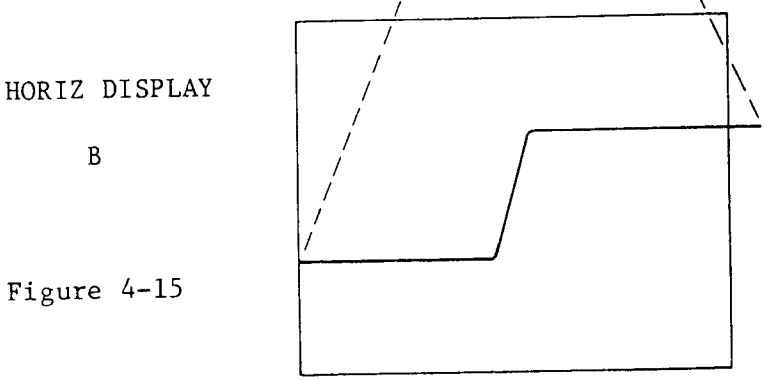


Figure 4-15

(2) Triggered delay:

When the displayed waveform is magnified by 100 times or higher in the above-mentioned continuous delay method, delay jitter is produced. To suppress the jitter, the triggered delay method may be used.

With the triggered delay, delay jitter is reduced by triggering the B sweep again after a sweep delay time as effected by the continuous delay method has elapsed.

For this operation the A trigger circuit continues to operate even after the B TRIG'D button is pushed in (⊓) and the B sweep is triggered by the triggering pulse. Therefore, even when the delay time is continuously varied by turning the TIME DELAY POSITION knob, the starting point of the sweep moves discretely, not continuously. In the A INTEN mode, this operation is characterized by discrete shifts of the brightness-accentuated section of the sweep across the CRT screen; while in the B mode this section remains stationary.

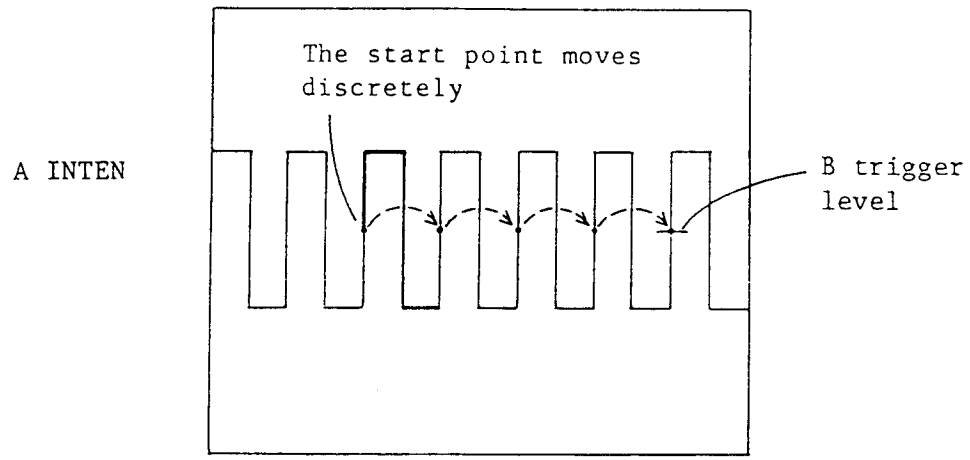


Figure 4-15

4.11 Calibration of Probe

As explained previously, the probe makes up a wide-range attenuator. Unless phase compensation is properly done, the displayed waveform is distorted causing measurement errors. Therefore, the probe must be properly compensated before use.

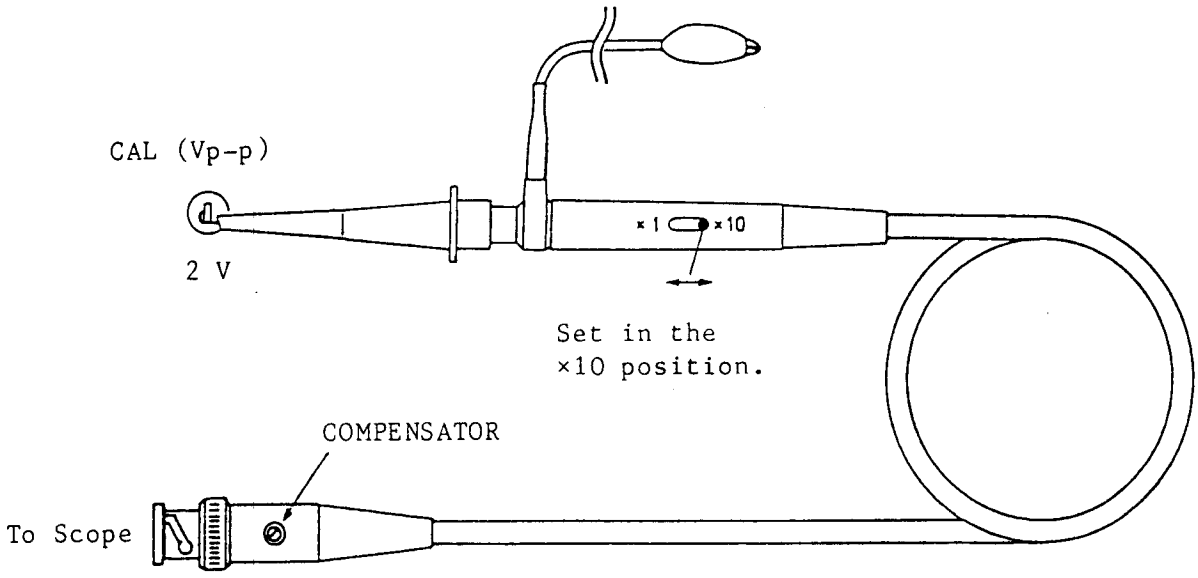


Figure 4-17

Connect the probe BNC to the INPUT terminal of CH1 or CH2 and set VOLTS/DIV switch at 50 mV. Connect the probe tip to the calibration voltage output terminal and adjust the COMPENSATOR control with an insulated screwdriver so that an ideal waveform as illustrated below is obtained.

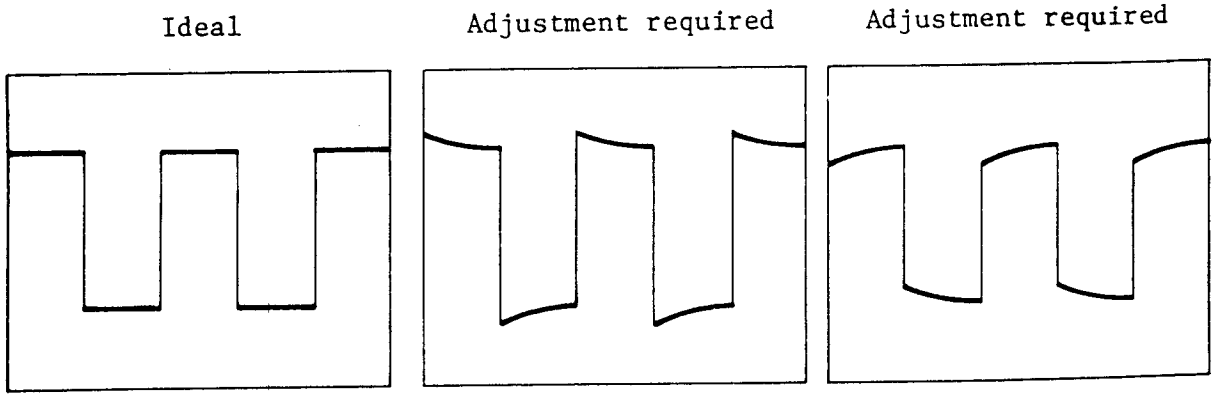


Figure 4-18

5. CIRCUIT DESCRIPTION

5.1 General

The overall circuit structure of the oscilloscope is as depicted with a block diagram in Figure 5-1. It is comprised of a vertical deflection circuit for moving the beam spot in the Y-axis direction on the CRT screen, a horizontal deflection circuit for operating the cathode-ray tube, a calibrator circuit for calibrating the instrument probe, and a power supply circuit for supplying powers to the various circuits of the instrument.

The vertical amplifier circuit has two mutually independent preamplifiers (CH1 and CH2), a vertical switching circuit, a delay line, and a vertical output amplifier.

Each of the preamplifiers amplifies or attenuates its input signal of several millivolts to several hundreds volts into a level suitable for handling by the subsequent stage. The conditioned vertical signals are sent to the vertical switching circuit. The trigger signals also are picked off at this stage.

The vertical switching circuit electronically switches the vertical signals received from the CH1 and CH2 preamplifiers. The switched signal is fed to the vertical output amplifier. The trigger signals also are switched and fed as internal trigger signals to the trigger generator.

The vertical output amplifier amplifies the vertical signal, which is received through the delay line circuit, into a level of several volts to several tens volts for vertically deflecting the beam spot on the CRT screen.

The horizontal deflection circuit has a trigger generator, sweep generators, a horizontal switching circuit, and a horizontal output amplifier.

The trigger generator receives the internal trigger signal from the vertical switching circuit or an external trigger signal from the EXT TRIG INPUT terminal and generates a trigger pulse signal.

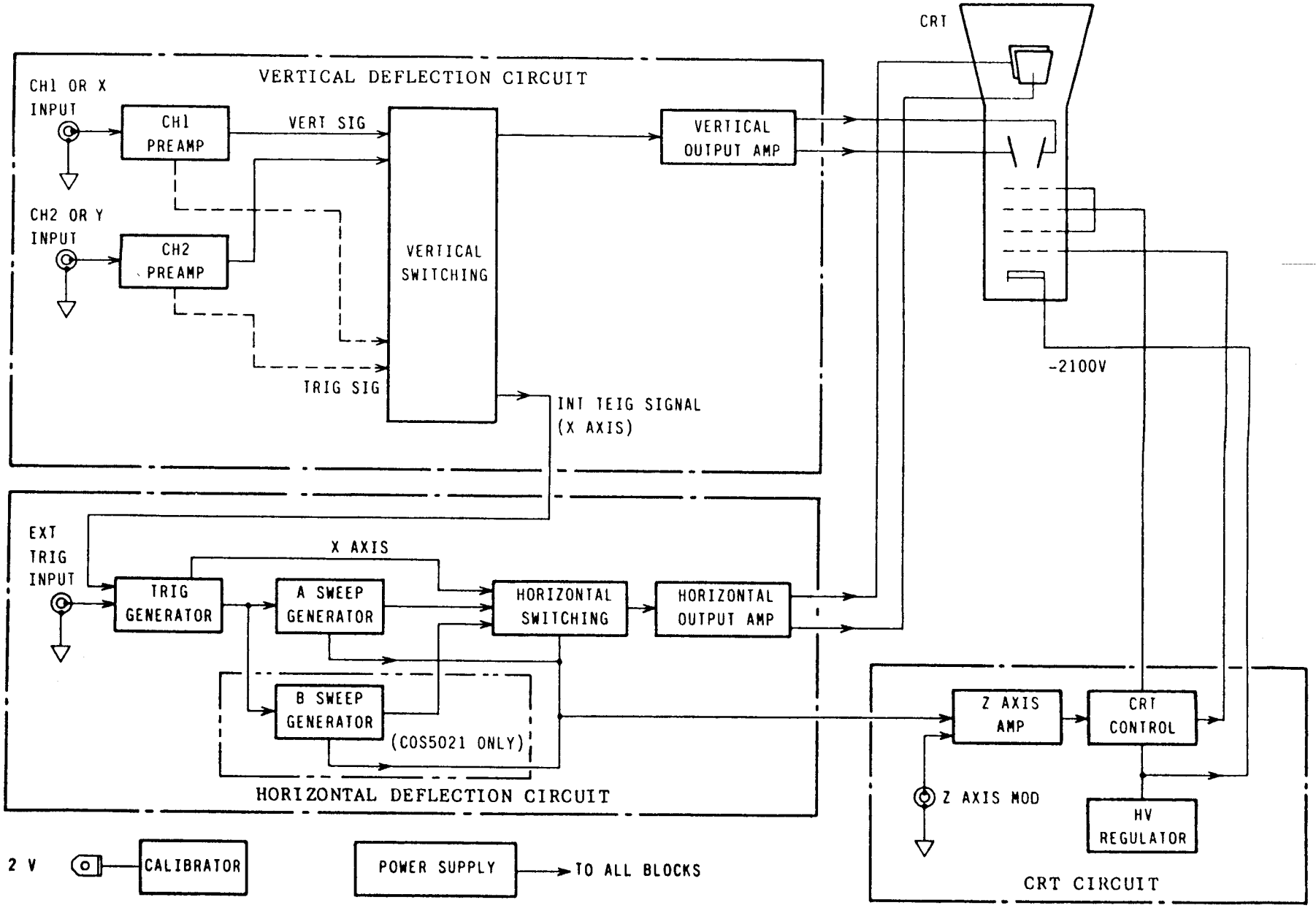

VERTICAL DEFLECTION CIRCUIT
CH1 OR X INPUT
CH1 PREAMP
VERT SIG
CH2 OR Y INPUT
CH2 PREAMP
VERTICAL SWITCHING
TRIG SIG
VERTICAL OUTPUT AMP
CRT
-2100V
INT TEIG SIGNAL (X AXIS)
EXT TRIG INPUT
X AXIS
TRIG GENERATOR
A SWEEP GENERATOR
HORIZONTAL SWITCHING
HORIZONTAL OUTPUT AMP
B SWEEP GENERATOR
(COS5021 ONLY)
HORIZONTAL DEFLECTION CIRCUIT
Z AXIS AMP
CRT CONTROL
Z AXIS MOD
HV REGULATOR
CRT CIRCUIT
2 V
CALIBRATOR
POWER SUPPLY
TO ALL BLOCKS

Figure 5-1

The A sweep generator is driven by the trigger pulse signal of the trigger generator and produces the A sawtooth signal. The sweep generator produces a sawtooth signal even when no trigger pulse is applied to it (the AUTO mode).

The B sweep generator produces the B sawtooth signal, being driven by the delayed sweep start signal produced with respect to the A sawtooth signal when in the continuous delay mode (HOR DISPLAY: B). When in the synchronized delay mode (HOR DISPLAY: B TRIG'D), the B sweep generator generates the B sawtooth signal being driven by the trigger pulse signal of trigger generator which follows the above delayed sweep start signal. (COS5021 ONLY)

The horizontal switching circuit electronically switches the sawtooth signals received from the A and B sweep generators and the CH1 HOR signal received from the vertical switching circuit when in the X-Y mode of operation, and sends the resultant signal to the horizontal output amplifier.

The horizontal output amplifier amplifies the output signal of the horizontal switching circuit to a level of several volts to several tens volts in order to drive horizontally the beam spot on the CRT screen.

The CRT circuit is comprised of a high voltage generator (the HV regulator) to accelerate the electron beam emitted from the CRT cathode, a Z-axis amplifier to amplify the signal to blank out the return traces, and a CRT control circuit to operate the CRT tube in its optimal state.

The HV regulator provides a 2.1 kV voltage which is applied to the CRT cathode to accelerate the electrons emitted by it.

The Z-axis amplifier amplifies the unblanking signals received from the A and B sweep generators and the trace intensity control signal to a level of several tens volts in order to be applied to the 1st grid (control grid) of the CRT via the CRT circuit.

The CRT circuit provides the various voltages for the CRT electrodes so that the CRT operates in an optimal state, displaying sharply-focussed less-distorted signal waveforms. It also conditions the signals received from the Z-axis amplifier and other circuits into levels suitable for application to the CRT.

5.2 Preamplifiers

The CH1 preamplifier amplifies the signal of the CH1 or X input terminal. The CH2 preamplifier amplifies the signal applied to the CH3 or Y input terminal. A detailed block diagram is shown in Figure 5-2.

- o Input coupling switch:

The input coupling switch (S102/S202) selects the input coupling mode for AC, GND, or DC. When the GND state is selected, the preamplifier input is isolated from the input terminal and is grounded so that the base line (0 level) on the CRT screen can be checked.

- o Attenuators:

Each of the CH1 and CH2 attenuator circuits consists of two attenuators: The 1st attenuator for 1/1, 1/10 and 1/100, and the 2nd attenuator for 1/1, 1/2, 1/4 and 1/10. By switching these attenuators with the VOLTS/DIV switch (S101/S201), the signal can be attenuated for a total range of 1/1 to 1/1000 in 10 steps.

The 1st attenuator directly attenuates the signal received from the input coupling switch and feeds the attenuated signal to the voltage follower. The 2nd attenuator attenuates the low-impedance output signal of the voltage follower and feeds the attenuated signal to the 1st differential cascade amplifier.

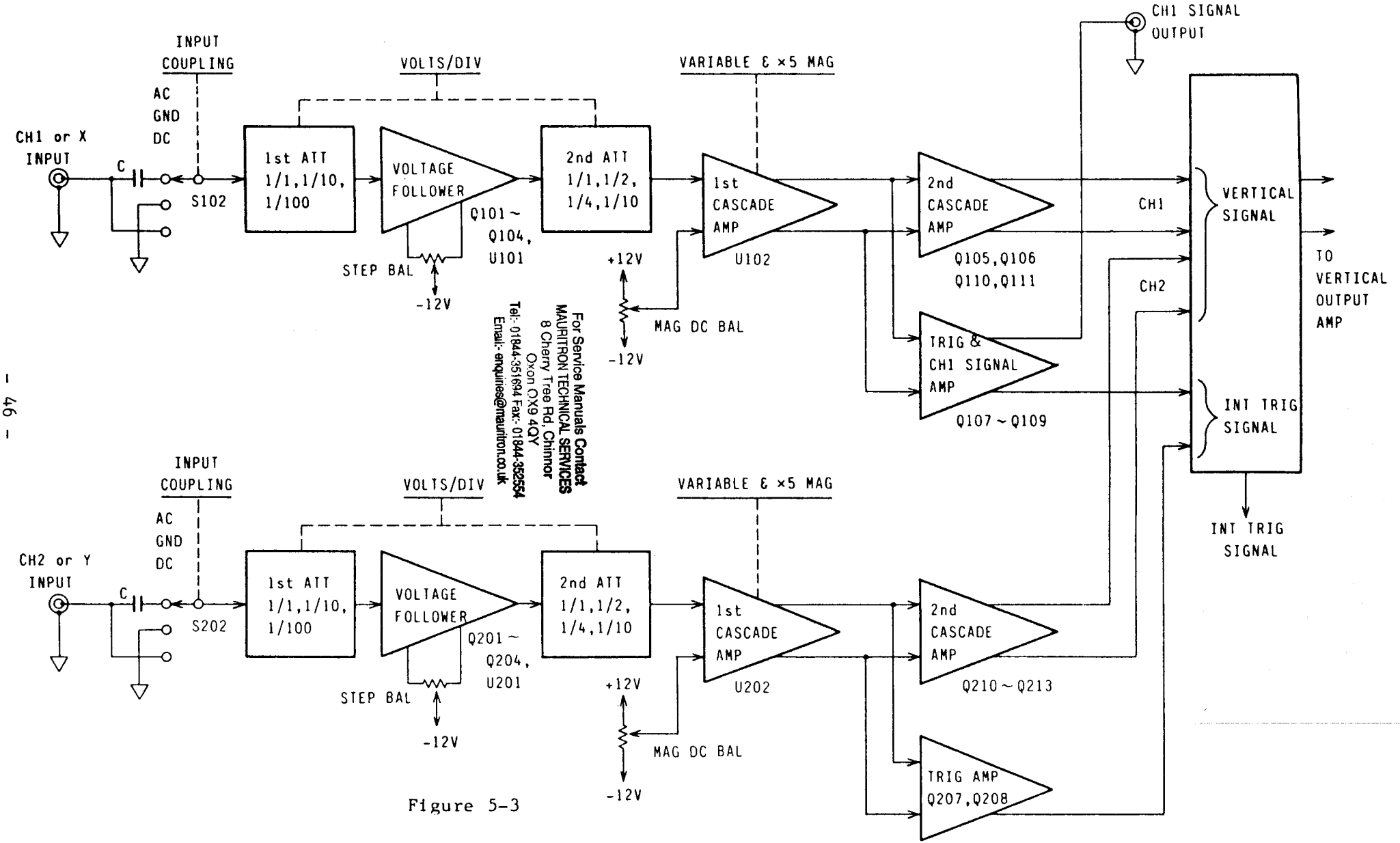


Figure 5-3

o Impedance converter:

The impedance converter provides with its source follower (Q101/Q201) a high input impedance to prevent the loading effect on the high-impedance attenuator circuit and provides a low output impedance with its emitter follower (CH1 and CH2) to drive the 1st differential cascade amplifier of the next stage. In order to guard against thermal drift, the source follower employs a dual-FET package which houses two thermally-coupled elements for thermal drift compensation and the emitter follower employs two premium-grade thermally-coupled transistors.

o 1st differential cascade amplifier:

The 1st differential cascade amplifier is comprised of an emitter-connected differential current amplifier (U102-1/2, U202-1/2) and a current-to-voltage converter (U102-2/2, U202-2/2) which converts the differential collector output current of the differential current amplifier into a voltage signal. This amplifier also has the VARIABLE circuit for continuously-variable adjustment of the sensitivity between two adjoining vertical deflection sensitivity ranges selected by the VOLTS/DIV switch and the ×5 MAG switch for magnifying the vertical sensitivity by 5 times to realize the 1 mV/DIV sensitivity.

o VARIABLE circuit:

The VARIABLE circuit continuously-variably adjusts the vertical sensitivity by shunting with potentiometer RV104/RV204 a part of the collector current amplified by U102-1/2 or U202-1/2. Adjustment (attenuation) can be done with a ratio of 1/2.5 or over.

o ×5 MAG circuit:

The ×5 MAG function is to increase the vertical sensitivity by 5 times by switching the emitter resistor of the 1st differential cascade amplifier.

o 2nd differential cascade amplifier:

The 2nd differential cascade amplifier (Q105, 106, 110, 111, or Q205, 206, 210 - 213) amplifies the output of the 1st differential cascade amplifier to a sufficient level for driving the vertical switching circuit. The grounded-base stage (Q110, 111/Q209 - 212) of this cascade amplifier has a function of preventing the switching signal of the vertical switching circuit from being returned to the preceding stage and mixed into the trigger signal or the signal of the CH1 signal output amplifier. For the CH2 signal, this amplifier also has a function of inverting its polarity. This polarity inverting function is accomplished by switching with the INV switch the base grounding stages of Q210/213 and Q211/212 to which the collector currents which have been current-amplified by Q205 and Q206 are fed in a crossing manner.

Different from the case of the 1st differential cascade amplifier, the output signal of the 2nd differential cascade amplifier is fed directly in the form of the current signal to the diode gate of the vertical switching circuit. The current signal for vertical positioning of the trace on the CRT screen is added to the output current signal of the 2nd differential cascade amplifier, being controlled by potentiometer RV111/211 of the positioning circuit.

o Trigger signal amplifier (& CH1 signal output amplifier):

This circuit amplifies with its Q107, 108/Q207, 208 the signal picked off from the 2nd differential amplifier, and converts with its Q109 the collector output of Q107 into a low-impedance CH1 output signal which is fed to J-6C. The collector output signal of Q108/Q208 is fed as a trigger signal to the internal trigger signal switching circuit.

5.3 Vertical Switching Circuit

The vertical switching circuit is comprised of a vertical signal switching circuit (diode gate circuit) which electronically switches the vertical signals received from the CH1 and CH2 preamplifiers,

an internal trigger signal switching circuit which electronically switches the trigger signals, and a switching logic circuit which controls these switching circuits.

The vertical signal switching circuit is, as shown in Figure 5-3, comprised of a diode gate circuit, an ADD BAL circuit, and a switching buffer circuit which receives the signal from the diode gate circuit.

o Diode gate circuit:

The diode gate circuit (CR103 - 106, CR203 - 206) selects the CH1 and CH2 signals being controlled by the signal of the switching logic circuit according to the mode selected by the VERT MODE switch (S301).

For example, when the VERT MODE switch is set at CH1, the CH1 control signal becomes the Hi state, and the CH2 and CH3 control signals become Lo state. Consequently the output signal of the CH1 preamplifier is fed through CR103 and CR106 to the switching buffer circuit consisting of Q305 and Q306. The signals of the other channels are fed through respective diodes (CR204/205) to the control circuit. Thus, the signal of CH1 alone is fed to the switching buffer circuit and the signals of the remaining channels are blocked.

o ADD BAL circuit

When the ADD mode is selected by the VERT MODE switch, the control signals of both CH1 and CH2 become the Hi state, the signals of the CH1 and CH2 preamplifiers are fed through CR103/106 and CR203/206 to the switching buffer circuit, and the two signals are fed as their sum signal to the output circuit. The function of the ADD BAL circuit is to compensate for the DC balance shift caused by the above addition operation, with its ADD BAL control (semi-fixed potentiometer RV301).

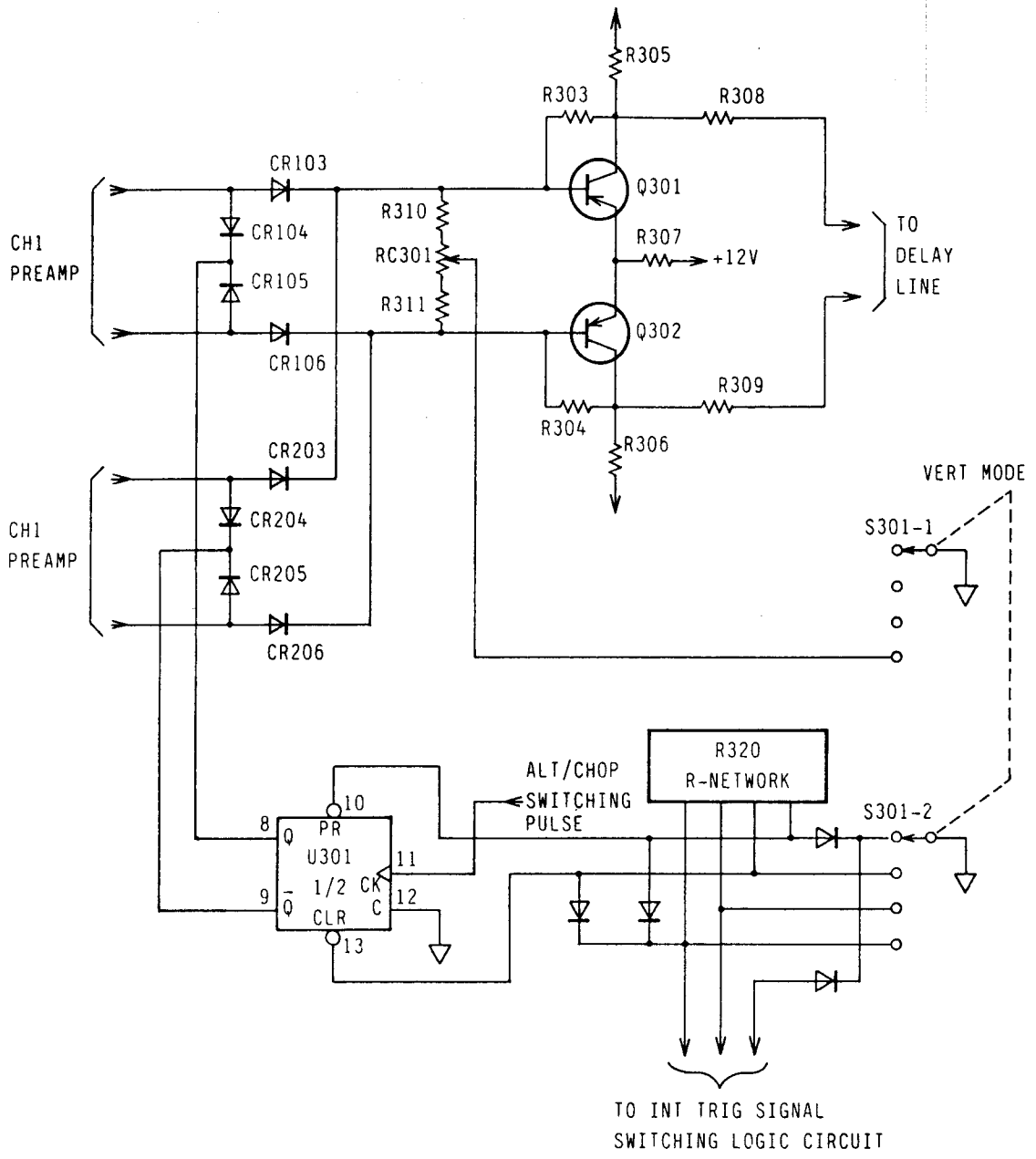


Figure 5-3

o Internal trigger signal switching circuit:

The internal trigger signal switching circuit directly controls, with the control signal from the switching logic circuit, the diode gate circuit (CR107, 108, 207, 208) which is similar to the vertical signal switching circuit. The trigger signal which has passed the diode gate circuit is delivered as the internal trigger signal via connector P-7.

o Switching logic circuit:

The switching logic circuit is comprised of a vertical switching logic circuit which controls the vertical signal switching circuit and an internal trigger switching logic circuit which controls the internal trigger signal switching circuit.

The vertical switching logic circuit is comprised of a flip-flops (U301) with preset/clear terminal. Switching of channels can be done by turning on and off the preset/reset terminal of the flip-flop.

The internal trigger switching logic circuit controls the internal trigger signal switching circuit by switching it for the mode selected by the VERT MODE switch and TRIG SOURCE switch. This relationship is shown in the following table.

VERT MODE \ TRIG SOURCE	CH1	CH2
CH1	Triggered by CH1	
CH2	Triggered by CH2	
DUAL	Triggered by CH1	Triggered by CH2
ADD	Triggered by CH1	Triggered by CH2

o Switching buffer amplifier:

The vertical signal which has passed the diode gate is fed to the switching buffer amplifier (Q301, 302). The vertical signal amplified by the switching buffer amplifier is fed to the vertical output amplifier via the P-9/J-9 connector and 2-conductor shielded cable.

5.4 Vertical Output Amplifier

The vertical amplifier is comprised of a drive amplifier and a final amplifier. The drive amplifier amplifies the signal received from the switching buffer amplifier and drives the final amplifier. The final amplifier amplifies the signal to a level sufficient for driving the vertical deflection plates of the CRT.

o Drive amplifier:

The drive amplifier (Q305, 306) is a feedback amplifier, with low output impedance for driving the final amplifier.

o **Final amplifier:**

The final amplifier boosts the signal to a level sufficient for driving the vertical deflection plates of the CRT. It is comprised of a pair of feedback-type SEPP amplifiers.

Transistors Q307, 308/Q309, 310 current-amplify the signal to a level sufficient for driving transistors Q312, 313/Q314, 315. The signal which has been voltage-amplified by transistors Q417, 418/Q419, 420 is returned to the input circuit through the negative feedback circuit (R435/R436). The gain in this case is as follows:

$$Av = \frac{R346}{R388} \qquad Av' = \frac{R347}{R339}$$

Transistors Q311/Q316 are for the dynamic bias circuit which controls the bias current with respect to the repetition frequency of the signal in order to economize current consumption.

5.5 Trigger Generator

The trigger generator is comprised of a trigger pulse generator circuit which produces a trigger pulse signal for driving the sweep generator and an AUTO circuit which produces a free-run signal for automatic sweep operation when the trigger signal is asynchronized or no trigger signal is applied.

The trigger pulse generator circuit of the trigger generator is comprised of a source switch which selects a trigger signal source, a coupling switch which selects a coupling mode in conformity with the nature of the trigger signal source, an impedance converter circuit which converts the high-impedance trigger source signal into a low-impedance signal with which to drive the level comparator circuit which controls the start point (triggered point) of the signal waveform displayed on the CRT screen, a TV synchronization separator circuit which picks off the synchronization signal from the TV video signal, and Schmitt trigger circuits which convert the output signals of the level comparator circuit and TV synchronization signal separator circuit into TTL level signals.

o Source switch:

The source switch (S401) selects the internal trigger signal fed from Q401, the line trigger signal fed from R662, the external trigger signal fed from P-12. The selected signal is fed to the coupling switch.

o Coupling switch:

The coupling switch (S402-1) selects the coupling mode: It selects the DC mode for direct coupling of the signal fed from S401, the AC mode for discarding the DC component, or the HF REJ mode for coupling via a low-pass filter. Switch S402-2 selects ON or OFF of the TV synchronization signal separator circuit which facilitates observation of a TV video signal.

o Impedance converter:

The impedance converter is a source follower (Q403) with FET. It converts the trigger signal selected by the source switch and coupling switch into a low-impedance signal, which is fed to drive the level comparator circuit (Q404, Q405).

o Level comparator:

The level comparator is a differential amplifier (Q404, 405), which adjusts the rise up portion (or the fall down portion) of the comparator output signal by applying the trigger source signal (the base signal of Q404) from the impedance converter circuit and applying the comparator level signal (the base signal of Q405) from the LEVEL control potentiometer (RV402-1). In this case, if switch S405 which is linked to the LEVEL control potentiometer is locked, the comparator level signal is applied to the base of Q405 from the level lock circuit and the trigger point is fed at the center amplitude of the trigger source signal.

The level lock circuit amplifies with its error amplifier (Q408, 409) the error signal detected by Q406 and Q407, and feeds back the signal so that the center level of the comparator output signal becomes the Schmitt level of the Schmitt trigger circuit.

It also selects a slope by switching the comparator output with the slope switch (S403-1).

The output signal of the level comparator is fed to the buffer amplifier which operates also as a signal separator circuit.

o Buffer amplifier/TV synchronization signal separator circuit:

This circuit operates either as a buffer amplifier or as a TV synchronization signal separator circuit, being selected by the transistor switching circuit (Q410, 411).

When Q410 is on and Q411 is off, the circuit operates as a buffer amplifier and amplifies the output signal of the level comparator to a level sufficient for driving the Schmitt circuit of the next stage.

When Q410 is off and Q411 is on, the circuit operates as a TV synchronization signal separator circuit and picks off the TV-H synchronization signal, which is pulsewidth-detected into a TV-V synchronization signal by the Schmitt circuit of the next stage.

- o TRIG Schmitt circuit:

The TRIG Schmitt circuit is a conventional circuit which generates a hysteresis voltage by applying a feedback signal with R440 to the two stages of NAND gates of 401. The output of the Schmitt circuit drives the A and B SWEEP generators and AUTO circuit.

- o AUTO circuit:

The AUTO circuit is comprised of a uni-junction transistor (UJT) circuitry made up by connecting mutually the bases and collectors of a PNP transistor (Q416) and an NPN transistor (Q415). This circuit converts the high-speed pulse output signal of the Schmitt circuit into a DC signal, with which to drive the A sweep generator.

5.6 A and B Sweep Generators

The A sweep generator produces the sawtooth signal for the main sweep (A sweep) of this oscilloscope. The B sweep generator produces the sawtooth signal for magnification in the time axis direction the waveform displayed on the main sweep or for display with a certain time delay (delayed sweep or B sweep).

The A sweep generator consists of the A sweep gate circuit which receives the trigger signal from the trigger generator and produces the sweep gate signal for starting sweeps, the sweep start comparator which maintains stably the sweep start point, the A sawtooth sweep generator which produces a sawtooth wave in conformity with the time constant selected by the TIME/DIV

switch, the sweep length circuit which controls the length of sweeps, the hold off circuit which controls the sweep return period and pause period, and the A sweep gate enable circuit which controls the sweep gate circuit in conformity with the AUTO, NORM or SINGLE mode as selected by the MODE switch for the signals of the above control circuits.

*: The B sweep generator is for the COS5021 only.

o A sweep gate:

The A sweep gate circuit employs a flip-flop TTL IC (U402-1/2) with preset/clear function. The trigger pulse of the trigger generator is applied to the CLOCK (Pin No. 1) terminal, the enable signal of the A sweep gate enable circuit to the CLEAR (Pin No. 15) terminal, and the enable signal and AUTO signal of the AUTO circuit to the PRESET (Pin No. 4) terminal through the NOR gate circuit. The Q (Pin No. 5) terminal output is applied as the unblanking signal to the Z-axis amplifier and the $\overline{Q}$ (Pin No. 6) terminal output is fed to the sweep start comparator circuit and becomes the A sweep gate signal. Even when no trigger pulse signal is applied to the CLOCK terminal, the $\overline{Q}$ output can be made the low state with the AUTO signal of the PRESET terminal so that the A sweep gate signal is generated and the circuit operates in the free-run mode.

o Sweep start comparator:

The sweep start comparator (Q419, 420) is a differential amplifier which lets the sweep gate signal pass and maintains constant the sweep start level. A start reference level identical with the B sweep start level is applied to one of the inputs, the Miller integrator output signal is applied to the other input, and the difference between the two signals is compensated for.

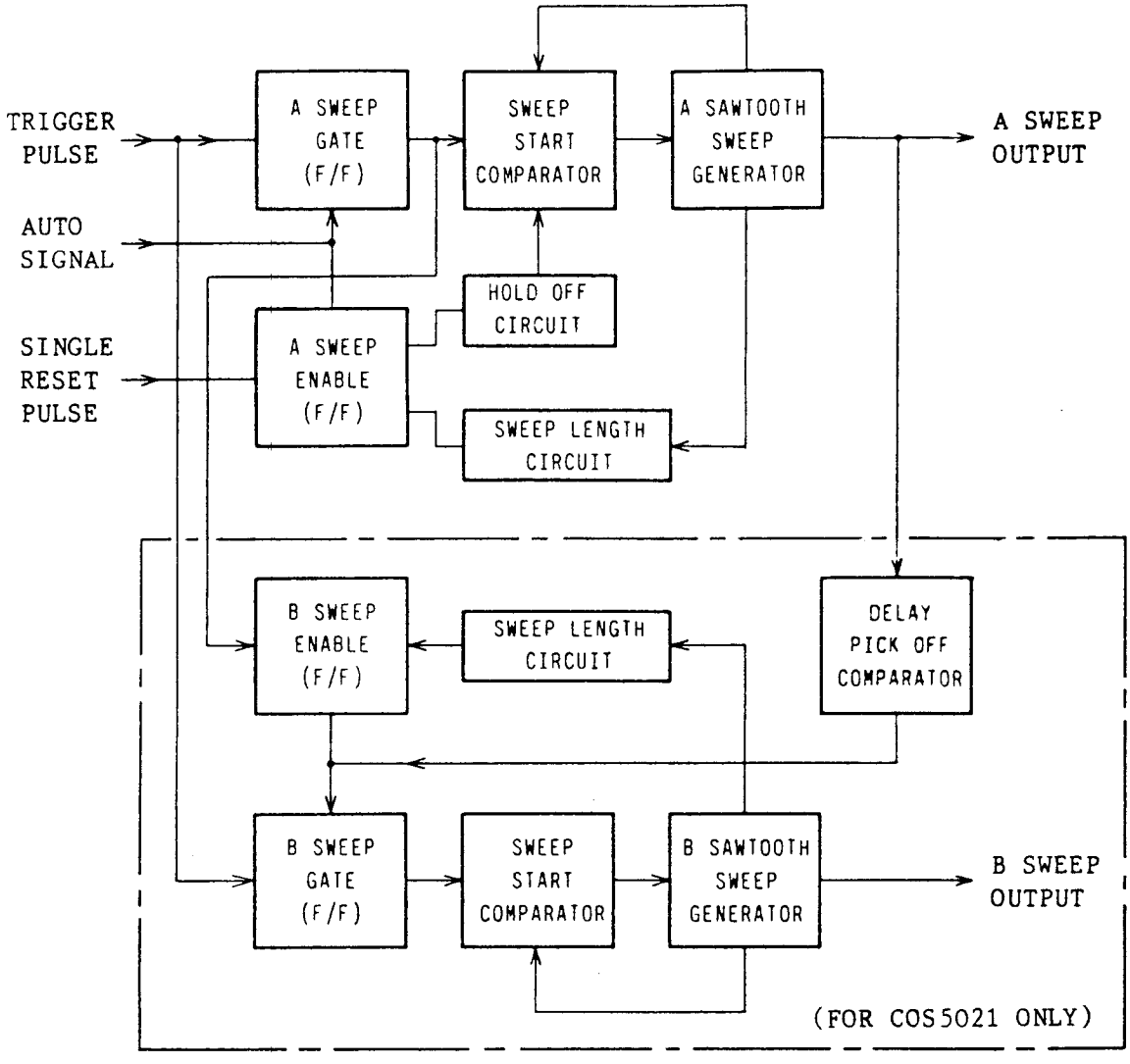

TRIGGER PULSE
AUTO SIGNAL
SINGLE RESET PULSE
A SWEEP GATE (F/F)
SWEEP START COMPARATOR
A SAWTOOTH SWEEP GENERATOR
A SWEEP OUTPUT
HOLD OFF CIRCUIT
A SWEEP ENABLE (F/F)
SWEEP LENGTH CIRCUIT
B SWEEP ENABLE (F/F)
SWEEP LENGTH CIRCUIT
DELAY PICK OFF COMPARATOR
B SWEEP GATE (F/F)
SWEEP START COMPARATOR
B SAWTOOTH SWEEP GENERATOR
B SWEEP OUTPUT
(FOR COS5021 ONLY)

Figure 5-4

o A sawtooth generator:

The A sawtooth generator is comprised of a gate transistor amplifier, a Miller integrator, an integration time constant switching circuit, and a TIME/DIV switch which controls the switching circuit. The gate transistor amplifier (Q423) controls the Miller integrator circuit in such manner that the start level control signal and sweep gate signal of the sweep start comparator do not affect the integration time constant. The Miller integrator (Q425) produces a sawtooth signal with the time constant selected by the integration time constant selector circuit. The integration time constant selector circuit selects integration capacitor C459/C460 with Q426. For integration current, resistor array (R491, 492, 493) is directly selected by the TIME/DIV switch (S406-1).

o Sweep length circuit:

This circuit divides the A sweep generator output by R461/R462 and shapes the waveform with Q418 to obtain a sweep length signal.

o Holdoff circuit:

The holdoff circuit generates a holdoff (pause) time signal proportional to the sweep time by producing a triangular wave with an integrator circuit and making use of the rise time of the triangular wave. The integrator, with its Q421, selects the time constant in accordance with the integration output voltage in order to cover a wide time range. The output signal of the integrator circuit is shaped by Q417 into a holdoff signal.

o A sweep gate enable circuit:

The A sweep gate enable circuit employs the flip-flop IC (U402-2/2) which makes up a pair with the A sweep gate circuit. The holdoff signal is applied to the PRESET (Pin No. 10) terminal, the length signal is applied to the CLEAR (Pin No. 14) terminal, and the enable signal is delivered from the Q (Pin No. 9) terminal. This enable signal presets or clears the A sweep gate circuit.

When in the NORM sweep mode, the output signal of the AUTO circuit is blocked and, if no trigger signal is applied, the circuit is in the ready state. When in the SINGLE sweep mode, the holdoff circuit remains idle and a one-shot sweep is effected by the reset signal applied from the CLOCK (Pin No. 13) terminal.

This paragraph is applicable to the COS5021 only: The basic structure of the B sweep generator is identical with that of the A sweep generator. It consists of the B sweep gate, sweep start comparator, B sawtooth generator, sweep length circuit, B sweep enable circuit, and delay pickoff comparator. The B sweep generator requires no holdoff circuit because it operates only during the period the A sweep generator is in the sweep operation. Instead of the holdoff signal, the A sweep gate signal sets the B sweep enable circuit to the enable state.

o Delay pickoff comparator:

The delay pickoff comparator (Q702 - 704) employs a differential comparator to obtain a certain time relationship as set by the delay time multiplication potentiometer (RV701) with respect to the A sweep signal. The comparator compares the A sweep output signal (sawtooth waveform) with the voltage set by RV701, generates a delayed sweep start signal, and sets the B sweep gate circuit to start the B sweep signal. When in the B TRIG'D mode, the B sweep gate circuit is not set directly with this delayed sweep start signal but the PRESET (Pin No. 4) terminal is set to the high state and the B sweep signal is started as driven by the trigger pulse of the trigger generator.

5.7 Horizontal Switching Circuit

The horizontal switching circuit is comprised of a switching buffer circuit which prevents switching distortion from being sent to the sweep circuit of the preceding stage, a display switching circuit which electronically switches the A and B sweep signals and CH1 HOR (X) signal, and a display switch (S702) to control these circuits. (The display switch is for the COS5041 only.)

o Switching buffer circuit:

The switching buffer circuit is of a grounded-base-type amplifier. Transistor Q430 is for buffer-amplification of the A sweep signal, transistor Q712 for the B sweep signal.

o Display switching circuit:

The display switching circuit, with its analog signal multiplexer IC (U404), selects the A and B sweep signals and CH1 HOR (X) signal.

5.8 Horizontal Output Amplifier

The horizontal output amplifier consists of a drive amplifier which selects between NORM and ×10 MAG mode for the horizontal signal received from the horizontal switching circuit and drives the output amplifier, and an output amplifier which drives the horizontal deflection plates of the CRT.

o Drive amplifier:

The drive amplifier (Q501 - 504) converts the horizontal signal received from the horizontal switching circuit into a differential signal, with which to drive the output amplifier. With Q501 and 502, gain of the differential amplifier can be multiplied by a factor of 10 for the ×10 MAG function.

o Output amplifier:

The output amplifier (Q505 - 512) is comprised of feedback-type SEPP amplifiers symmetrical for right and left which provide sufficient speed and output voltage for driving the horizontal deflection plates of the CRT. The signal cirrent-amplified by Q505/Q506 is converted into a voltage signal by Q507 - Q512 to obtain a sufficiently high gain and a sufficiently low output impedance. By means of negative feedback resistor R518/R519 a stable gain and wide and flat frequency response are attained.

5.9 Z-axis Amplifier

The Z-axis amplifier is comprised of an input circuit and an output amplifier. The input circuit merges the unblanking signals of the A and B sweep generators, the external intensity modulation signal applied through the Z-axis input terminal, the B intensity control signal, and the overall intensity control signal. The output amplifier amplifies the merged signal into a sufficient level for driving the G1 grid of CRT.

- Input circuit:

The input circuit merges the unblanking signals of the A and B sweep generators, the chopped blanking signal, the external intensity modulation signal applied via the X-axis input terminal, and the overall intensity control signal. The resultant compound signal is fed to the output amplifier.

- Output amplifier:

The output amplifier amplifies the above compound signal to several tens volts. It is of a feedback-type SRPP circuit (Q654, 656, 658). This amplifier also generates (with its Q655, 657, 659) a linear focus signal which is in the inverted phase of the unblanking signal. The amplified unblanking output signal and linear focus signal are fed to the G1 and P1 of the cathode-ray tube through the CRT circuit to drive the intensity and focus of the displayed waveform.

5.10 CRT Control Circuit

The CRT control circuit is comprised of a DC regeneration circuit which converts the linear focus signal and the unblanking output signal of the Z-axis amplifier into the operating-voltage signals of the CRT in order to be applied to the focus electrode and G1 electrode of the CRT, semi-fixed potentiometers ASTIG (RV652), GEOMETRY and SUB-FOCUS (RV651), a trace rotation circuit for adjusting the trace direction in parallel with the horizontal graticule lines, and an illumination circuit for illuminating the graticule.

o DC regeneration circuit:

The DC regeneration circuit converts the linear focus signal and unblanking signal of several tens to several hundreds volts into AC signals with the switching signal of the DC-DC converter circuit, and then converts them back into DC signals with respect to the cathode voltage and focus reference voltage of the sub-focus potentiometer in order to provide a focus signal and an unblanking signal of the operating voltages of the CRT.

5.11 HV Regulator (High Voltage Generator)

The high voltage generator produces an acceleration voltage (-2100 V) applied to the CRT cathode. The circuitry is a DC-DC converter with blocking oscillator (Q651), with resonance of the secondary coil winding. The high voltage of approximately 4200 Vp-p (frequency approximately 30 kHz) generated by the blocking oscillator and it is half-wave rectified into a negative voltage of -2100 V.

This DC-DC converter feeds the negative voltage via a high resistance circuit (R661, R662) to the control circuit (U651) to obtain a stabilized acceleration voltage. It also is fed through a capacitor-coupling circuit to the DC regeneration circuit in order to be used as the switching signal.

5.12 Power Supply Circuit

The power supply circuit steps up or down with its power transformer the AC line voltage into various voltages and rectifies them to DC supply voltages for the various circuits of the oscilloscope. The primary winding of the power transformer is of a split type, in order that the oscilloscope can be operated on various AC line voltages by connecting the transformer taps in series or parallel as required by means of the line voltage selector plug (P-47). Regarding the secondary circuit, the transformer has one 6.3 V winding for the CRT heater and two windings of different voltages for different circuits of the CRT. The AC voltages of the two windings are rectifies and supplied as non-regulated +16 V power and regulated +160 V, +12 V, +5 V, and -12 V powers.

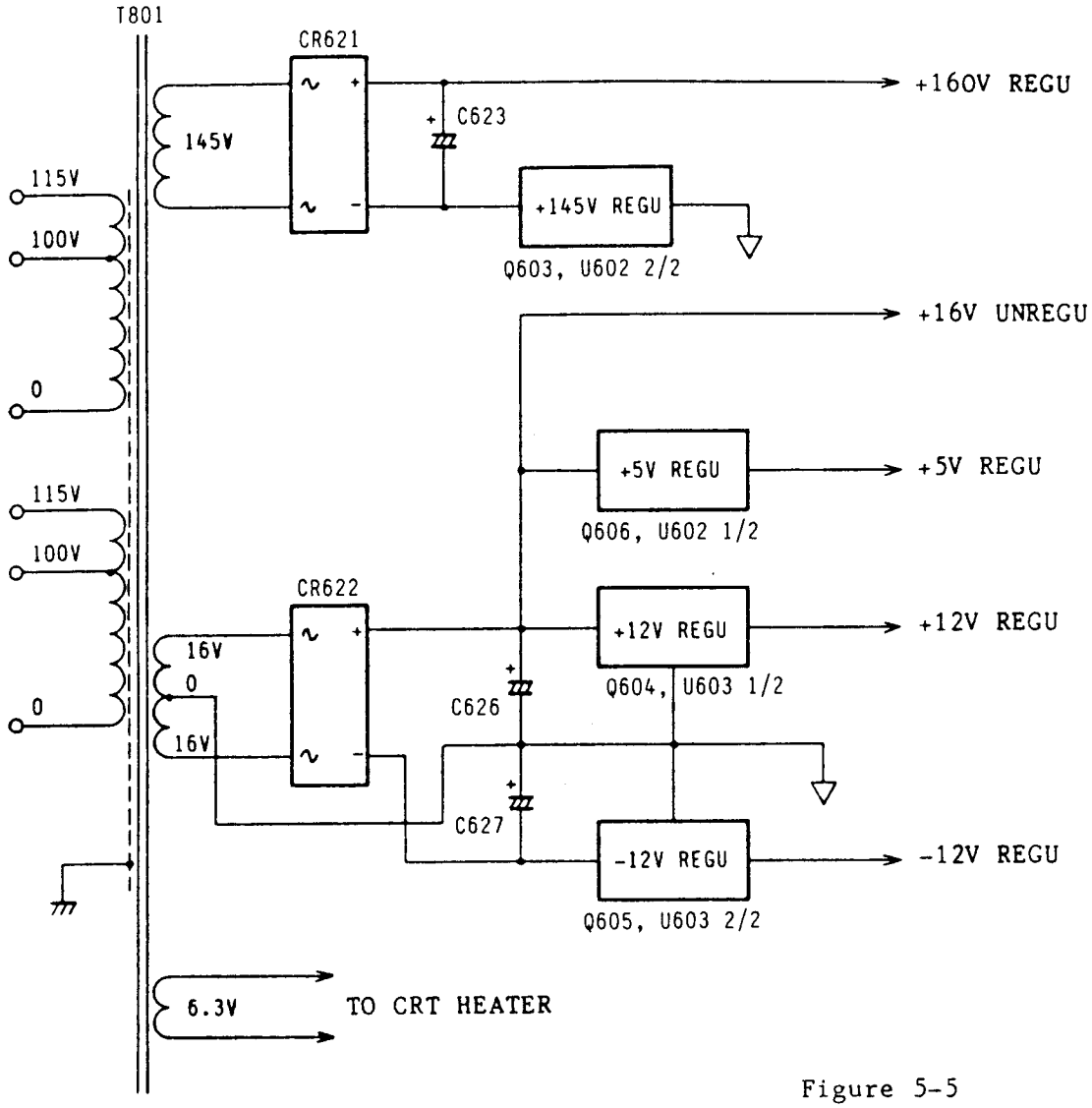


Figure 5-5

5.13 Calibrator Circuit

The calibrator circuit provides square-wave calibration voltage signal of 2 Vp-p which is used for calibration of the probe and the amplifiers when they are operated in the non-calibrated mode. The voltage accuracy of the calibration signals is 2% or better. The calibration signal is produced by generating a signal with the multivibrator of CMOS IC (U1601 1/4, 2/4), shaping the waveform with the Schmitt circuit of CMOS IC (U1601 3/4, 4/4), and dividing the voltage signal with resistors.

6. CALIBRATION

6.1 General

After the oscilloscope has been used for a period of time, it should be calibrated. Although calibration of overall performances is recommended, partial calibration may serve the purpose as that the time axis alone is calibrated when the time measuring accuracy is especially important or that the vertical axis alone is calibrated when the vertical sensitivity accuracy is of prime importance. After the oscilloscope has been repaired, overall calibration is suggested although it depends on the type of repair. For accurate calibration service, contact your Kikusui agent.

6.2 Removing the Case

To remove the case, remove the nine screws (Figure 6-1) and detach the top panel upward and the bottom panel downward.

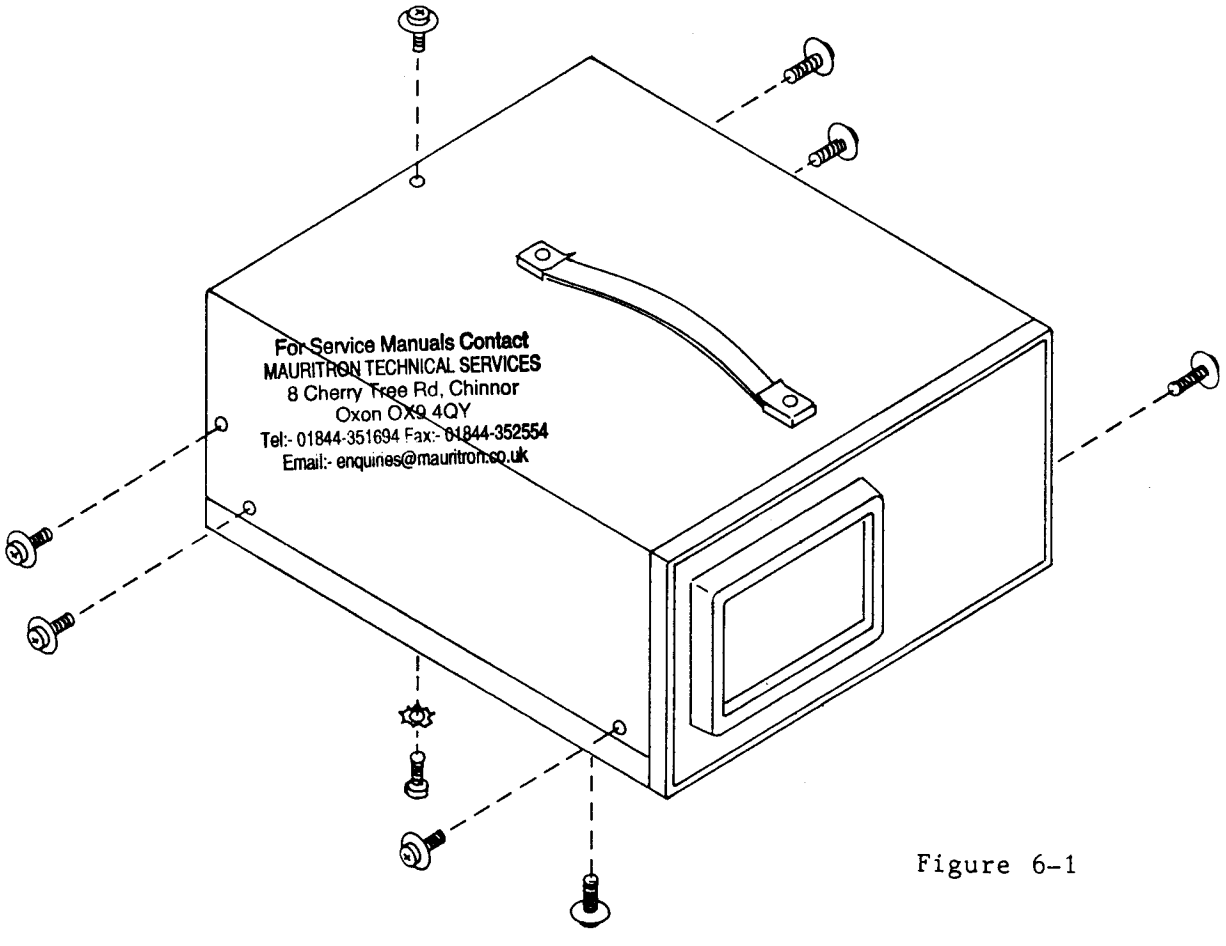


Figure 6-1

6.3 Check and Adjustment of DC Supply Voltages

Before calibrating the oscilloscope, its DC supply voltages should be checked and adjusted. Check and adjust the +12V supply voltage first and the other supply voltages next. The supply voltages are shown in the following table and the check and adjustment points are indicated in Figure 6-2.

Nominal voltage	Tolerance	Check and adjustment points
+5 V	+4.75 to +5.25 V	
+12 V	+11.95 to +12.05 V	RV606 (Figure 6-2)
-12 V	-11.80 to -12.20 V	
+160 V	+155 to +165 V	
-2100 V	-2050 to -2150 V	P36, Pin No. 3 (Figure 6-5)

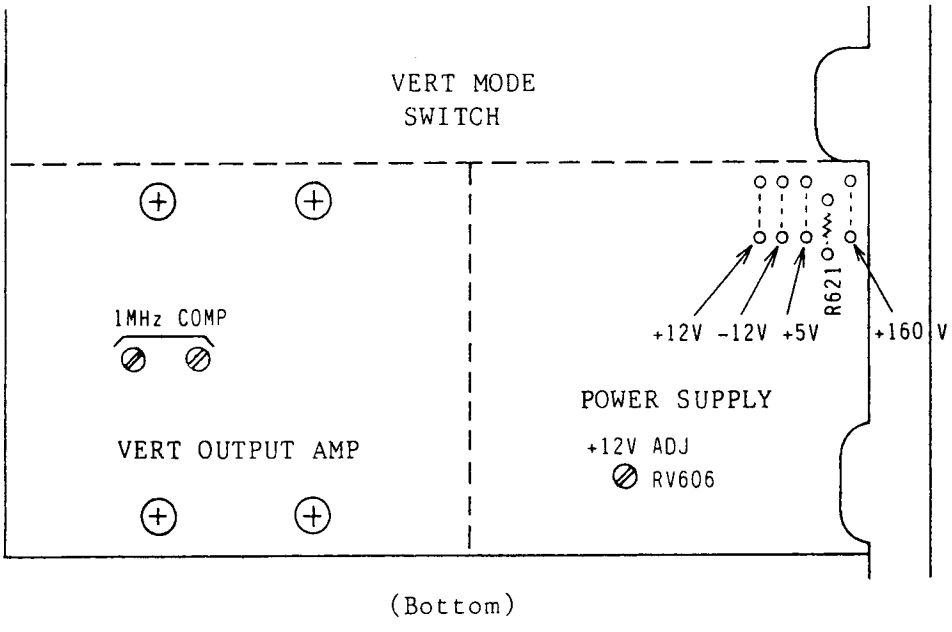


Figure 6-2 A1 printed circuit board

For voltage check, measure the voltage between check point and ground using precision digital voltmeter. The +12V supply must be especially carefully adjusted because it provides a reference for other supplies. To measure the -2100V supply of which internal impedance is high, use a voltmeter which as a sufficiently high input impedance (10 MΩ or over).

Because adjustments of supply voltages largely affect vertical sensitivity and horizontal sweep time, the oscilloscope must be re-calibrated as explained in the subsequent paragraphs.

6.4 Adjustment of CRT Circuits

Some adjustments of the CRT circuits directly affect the CRT deflection sensitivity as is the case of "Check and Adjustment of DC Supply Voltages" of the preceding section.

- o Adjustment of SUB INTEN:

This control is for adjusting the trace intensity and the operating position of the INTEN knob (4).

(1) Set the TIME/DIV switch (30) at 1 mS and display a single-line horizontal trace on the screen.

(2) Set the white mark of the INTEN knob at the 10 o'clock position and so adjust the SUB INTEN control (Figure 6-5, RV653) that the trace is displayed on the screen with a barely discernible intensity.

- o Adjustment of SUB-FOCUS:

This control is for adjusting the control range position of the FOCUS knob (6). With the FOCUS knob set with its white dot positioned upright (noon position), so adjust the SUB-FOCUS control (Figure 6-5, RV651) that the best focus is obtained.

o Adjustment of ASTIG:

This control is for focus adjustment of the electron lens of the CRT.

(1) Set the TIME/DIV switch (30) to the [X-Y | EXT HOR] position and display the beam spot in the center of the CRT screen with the POSITION controls.

(2) Turn the FOCUS control (6) to an appropriate position and then adjust the ASTIG control (Figure 6-5, RV652) so that the shape of the displayed beam spot becomes as true circle as possible.

6.5 Adjustment of Vertical Axis

o Adjustment of STEP BAL:

This control is for minimizing the shift of trace when the VOLTS/DIV switch (12) or (16) is turned from the 5 mV position to the 10 mV position.

(1) Set the AC-GND-DC switch (10) or (19) and display the trace on the CRT screen.

(2) Turning the VOLTS/DIV switch between 5 mV and 10 mV positions, so adjust the STEP BAL control (Figure 6-6, RV101 or RV201) that the shift of trace becomes minimum.

o Adjustment of ×5 MAG BAL:

This control is for minimizing the shift of trace when the ×5 MAG switch (13) or (17) is changed.

(1) Set the AC-GND-DC switch (10) or (19) in the GND state and display a trace on the screen.

(2) Turning on and off the ×5 MAG switch, so adjust the MAG DC BAL control (Figure 6-6, RV112 or RV212) that the shift of trace becomes minimum.

o Adjustment of VAR DC BAL:

This control is for minimizing the shift of the trace when the VARIABLE KNOB (13) or (17) is turned.

(1) Set the AC-GND-DC switch (10) or (19) in the GND state and display the trace on the CRT screen.

(2) Turning the VARIABLE knob, so adjust the VAR DC BAL control (Figure 6-6, RV105 or RV205) that the shift of the trace becomes minimum.

o Sensitivity calibration of CH1 and CH2:

Calibrate the sensitivity of the vertical amplifier to the value indicated by the VOLTS/DIV switch (12) or (16). For this adjustment, use a square wave generator with an output voltage setting accuracy of 0.3% or better, at 1 kHz.

(1) Set the signal generator output at 50 mVp-p and apply the signal to the vertical input terminal (11) or (18).

(2) Set the VARIABLE knob (13) or (17) at the CAL'D position and set the VOLTS/DIV switch at the 10 mV range.

(3) So adjust the CH1 or CH2 GAIN control (Figure 6-6, RV110 or RV210) that the amplitude of the displayed waveform becomes 5 DIV.

By the above procedure, other ranges also are calibrated to an accuracy of ±3% or better.

o Sensitivity calibration of ×5 MAG:

In a similar manner as for sensitivity calibration of CH1 and CH2, calibrate the sensitivity for the ×5 MAG function.

(1) Set the signal generator output at 10 mVp-p and apply the signal to the vertical input terminals (11) and (18).

(2) Set the VARIABLE knob (13) or (17) at the CAL'D position, set the VOLTS/DIV switch (12) or (16) at the 10 mV range, and pull out the CH1 ×5 MAG switch (13) or (17).

(3) So adjust the CH1 or CH2 GAIN control (Figure 6-6, RV102 or RV202) that the amplitude of the displayed waveform becomes 5 DIV.

By the above procedure, other ranges also are calibrated to an accuracy of ±5% or better.

o Adjustment of ADD BAL:

With both CH1 and CH2 channels operating in a single-line horizontal trace state at the center of the screen, so adjust this control that the traces do not shift even when the VERT MODE switch is changed to the ADD mode.

(1) Set the AC-GND-DC switches (10) and (19) in the GND state and display the traces of the two channels overlapped at the center of the screen.

(2) Change the VERT MODE switch to the ADD state and so adjust the ADD BAL control (Figure 6-6, RV301) that the traces are positioned at the center of the screen.

o Adjustment of square wave characteristics of vertical amplifiers:

This adjustment is to adjust the square wave characteristics of the vertical amplifiers and to make their frequency response flat. This adjustment should be done at a range which does not use the input attenuator (10 mV/DIV range), using a square wave of 1 MHz.

Adjustment should be done using a quality square wave with a rise time of 1.0 nsec or faster, in the order of middle and high ranges, repeating adjustment for a few times.

(1) Adjustment for middle frequency range:

Set the VOLTS/DIV switch at 10 mV/DIV and the TIME/DIV switch at 20 μS/DIV. Apply to the vertical input terminal a square wave of 1 MHz and so adjust the signal generator output that the waveform is displayed with an amplitude of 6 DIV.

Then, so that the waveform becomes as shown in Figure 6-3 (b), adjust RV302 and C331 (Figure 6-6) first and RV109 and C171 (RV209 or C271 for CH2) next.

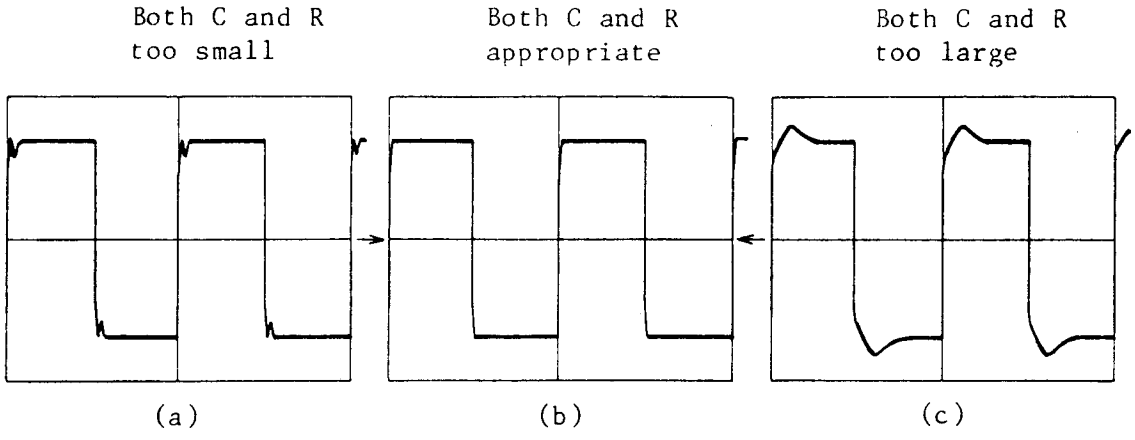


Figure 6-3

(2) Adjustment for high frequency range:

This adjustment is to make still more sharp the leading edge and reduce ringing at the leading edge of the pulse waveform which has been adjusted in step (1).

For this adjustment, adjust CH1 and CH2 to the same characteristics.

Change the TIME/DIV switch to the 0.2 μS/DIV position and expand the front edge of the pulse waveform which has been adjusted in step (1) "Adjustment for middle frequency range." Next, adjust RV103 and C131 (RV203 and C231 in the case of CH2) so that the leading edge of the pulse waveform becomes sharp.

Repeat the above adjustment so that flat square wave characteristics with sharp leading edge is obtained and the difference between CH1 and CH2 becomes minimum.

After the above adjustment is done, check again that the frequency response characteristics of both channels are satisfactory.

o Adjustment of input ATT of CH1 and CH2:

The VOLTS/DIV switch selects the oscilloscope sensitivity by switching the attenuator circuit consisting of the 1st attenuator (1/1, 1/10, 1/100 steps) and the 2nd attenuator (1/1, 1/2, 1/4, 1/10 steps). This procedure is for phase compensation and input capacitance adjustment of the attenuators. Adjustments should be done in the order of phase compensation and input capacitance adjustment.

Use a square wave signal generator which provides a quality square wave of rise time 1 μsec or faster, without sags or overshoots. Apply the signal for each of the ranges (0.1 V, 1 V) and display a waveform with an amplitude of 6 DIV. So adjust the phase compensation capacitors shown in the following table (see Figure 6-6) that an ideal waveform is displayed. Next, connect a low-capacitance C-meter to the input terminal and so adjust the input-capacitance compensation capacitor that the input capacitance at each range becomes 25 pF ±2 pF.

Compensation capacitor / Range	CH1		CH2	
	Phase compensation	Input capacitor	Phase compensation	Input capacitor
0.1 V (1/10)	C103	C102	C203	C202
1 V (1/100)	C106	C105	C206	C205

o Adjustment of CH1 SIGNAL OUTPUT DC OFFSET:

* This adjustment must be made after "Adjustment of CH1 TRIG OFFSET" of Section 6.6 has been done.

This adjustment is to make zero the DC offset of the CH1 signal output with the DC OFFSET control.

(1) Apply the CH1 signal output to the CH2 input terminal using a coaxial cable.

(2) Display the CH2 input signal on the screen and set the VOLTS/DIV switch at the 10 mV range.

(3) Changing the CH2 input coupling switch between GND and DC, so adjust the CH1 SIGNAL DC OFFSET control RV108 (Figure 6-6) that shift of the trace becomes zero.

6.6 Adjustment of Trigger Circuit

o Adjustment of CH1 TRIG DC OFFSET:

This adjustment is for offsetting to zero the DC-component displacement of the CH1 internal trigger output.

(1) Apply a sinusoidal signal of approximately 1 kHz to the CH1 input terminal and set the AC-GND-DC switch at AC.

(2) Set the VERT MODE switch at CH1, set the INT TRIG switch at CH1 or ALT, and display the signal with an amplitude of 8 DIV on the screen.

(3) Set the COUPLING switch at AC and so adjust the LEVEL knob that the trigger point is brought to the center of the displayed waveform amplitude.

(4) Change the COUPLING switch to DC and so adjust the CH1 TRIG & X-AXIS DC OFFSET (Figure 6-6, RV107) that the trigger point is brought to the center of the displayed waveform amplitude.

o Adjustment of CH2 TRIG DC OFFSET:

This adjustment is for offsetting to zero the DC-component displacement of the CH2 internal trigger output.

For this adjustment, adjust CH2 TRIG DC OFFSET (Figure 6-6, RV207) in a similar manner as is the case of "Adjustment of CH1 TRIG DC OFFSET."

6.7 Adjustment of Time Base

o Calibration of A sweep time:

This adjustment is for calibrating the sweep time to the values indicated by the TIME/DIV switch (30). For this adjustment, use time marker signals of accurate time intervals of 1 msec and 1 μsec or use signals of accurate frequencies of 1 kHz and 1 MHz.

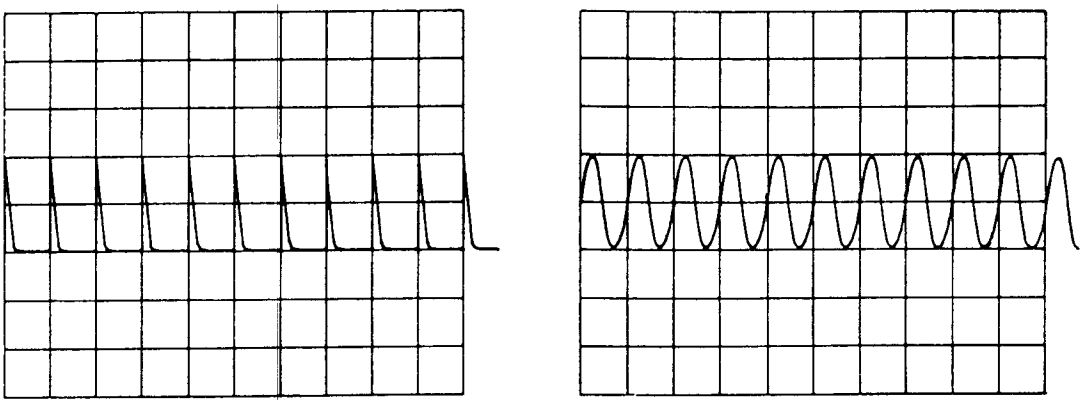
(1) Apply to the vertical input terminal a time marker signal of 1 msec or sinusoidal wave signal of 1 kHz and set the TIME/DIV switch (30) at 1 mS.

(2) So adjust the 1 mS CAL (Figure 6-5, RV405) that the displayed signal waveform conforms with scale divisions of the graticule.

(3) Next, change the input signal to a 1-μsec time marker signal or a 1-MHz repetitive frequency signal and change the TIME/DIV switch indication to 1 μS.

(4) So adjust RV404 (Figure 6-5) that the displayed signal waveform conform with scale divisions of the graticule.

When the above calibration is complete, the sweep speeds of the remaining ranges of the TIME/DIV switch (30) also are calibrated to an accuracy of ±2% or better.



Time marker signal　　Sinusoidal wave signal

Figure 6-4

o Calibration of B sweep time (for COS5021 only):

Calibrate the sweep time to the indicated values of the TIME/DIV switch (33). Adjust 1μS (Figure 6-5, RV703) in a similar manner as that for the case of "Calibration of A sweep time."

o Adjustment of sweep start points (for COS5021 only):

This adjustment is for aligning the start points of the A and B sweeps.

(1) Set the TIME/DIV switches (30) and (33) at 0.5mS, set the DISPLAY switch (29) at ALT, and display the A trace on the screen.

(2) So adjust the horizontal POSITION knob (32) that the start point of the A trace is brought to the left hand end of the graticule.

(3) Next, with the B SWEEP START POSITION control (Figure 6-5, RV702), bring the start point of the B trace to the left hand end of the graticule.

6.8 Adjustment of Horizontal Axes (X-axis)

o Calibration of horizontal sensitivity:

This adjustment is for calibration of the X-axis sensitivity for X-Y operation.

After this adjustment is done, "Adjustment of CH1 SIGNAL OUTPUT DC OFFSET" of Section 6.5 and "Adjustment of CH1 TRIG DC OFFSET" of Section 6.6 must be done.

(1) Set at 100 mVp-p the output of the signal generator used for "Calibration of sensitivity" of Section 6.5, and apply the output to the CH1 (X) input terminal (11) .

(2) Set the TIME/DIV switch (30) at [X-Y | EXT HOR], the SOURCE switch (26) at [X-Y], the COUPLING switch (25) at DC, and the VERT MODE switch (14) at [X-Y].

(3) So adjust the X-GAIN control (Figure 6-6, RV106) that the horizontal length of the trace becomes 10 DIV.

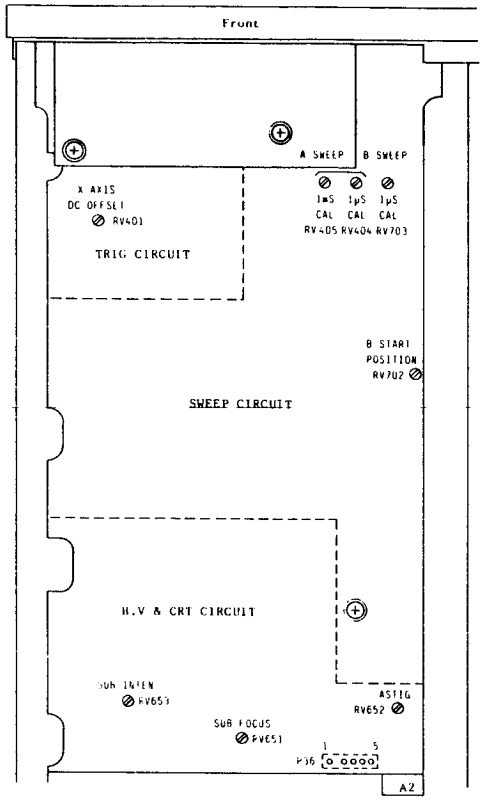
o Adjustment of X-Y POSITION ADJ:

This adjustment is for adjusting the positional relationship for the ↔ POSITION control when operation is switched between the NORM sweep mode and the [X-Y | EXT HOR] mode.

(1) Set the TIME/DIV switch (30) at 1 mS/DIV. Align the start point of the sweep with the left hand end of the CRT graticule with the ↔ POSITION control (32) .

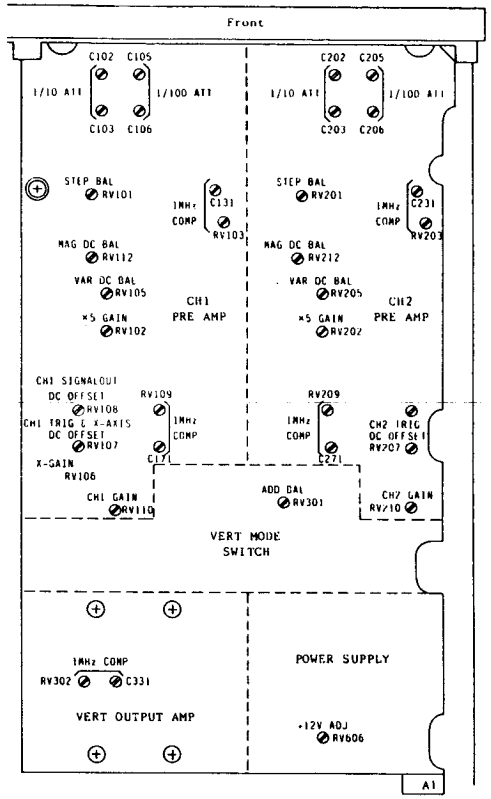
(2) Change the TIME/DIV switch (30) to the [X-Y | EXT HOR] to select the X-Y mode.

(3) So adjust the X-AXIS DC OFFSET control (Figure 6-5, RV401) that the beam spot is positioned at the center of the CRT graticule.



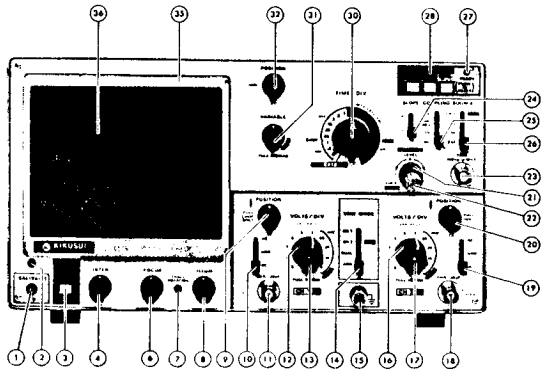
UPPER PRINTED CIRCUIT BOARD

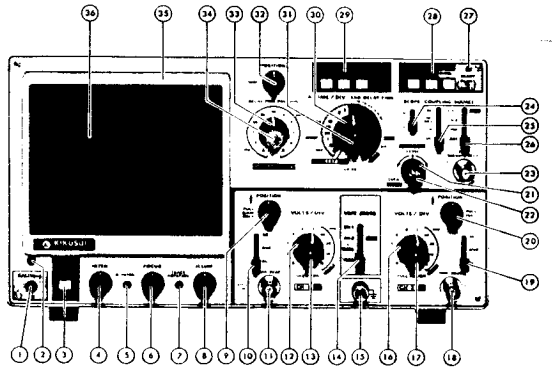
Figure 6-5

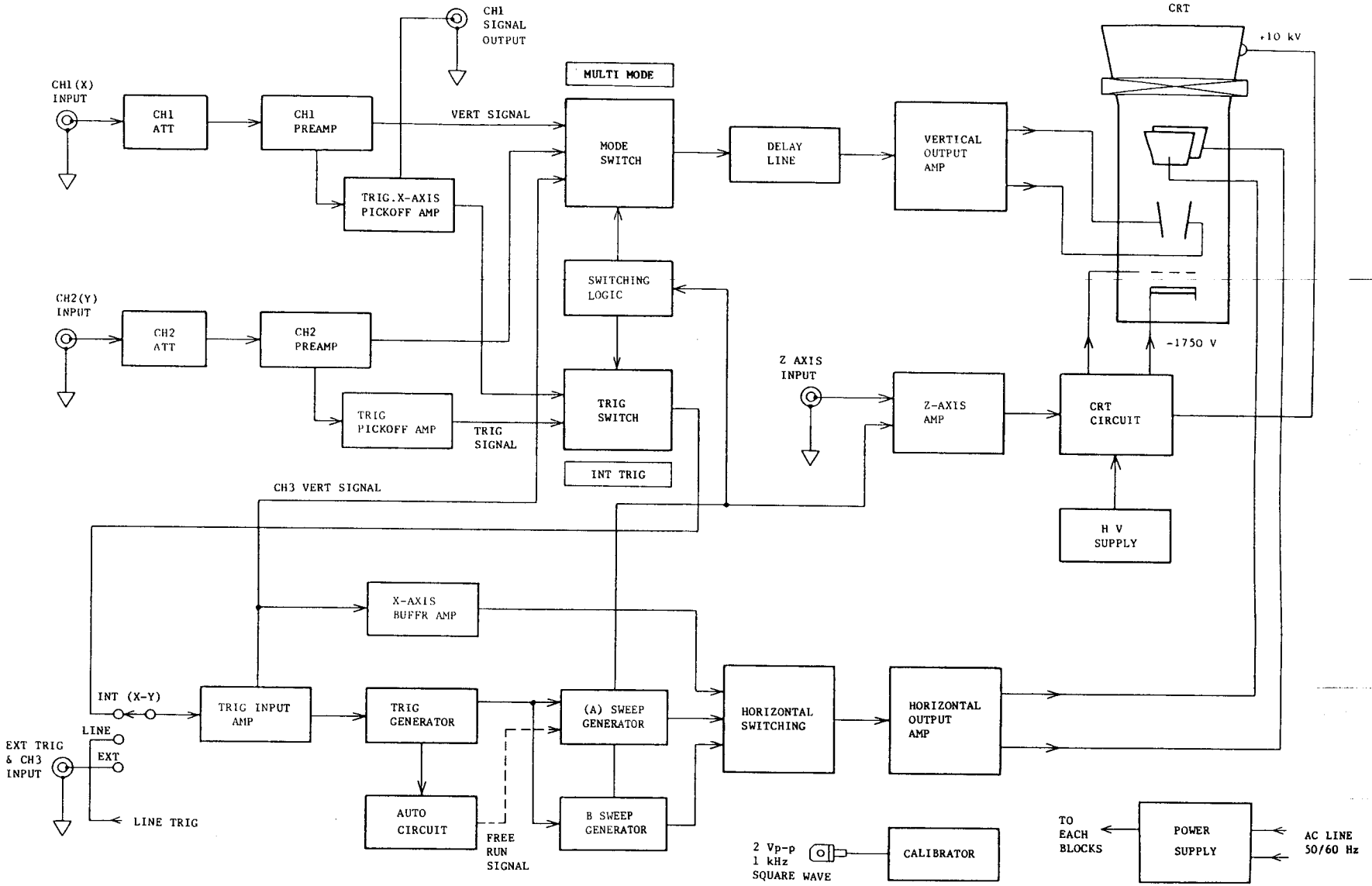


LOWER PRINTED CIRCUIT BOARD

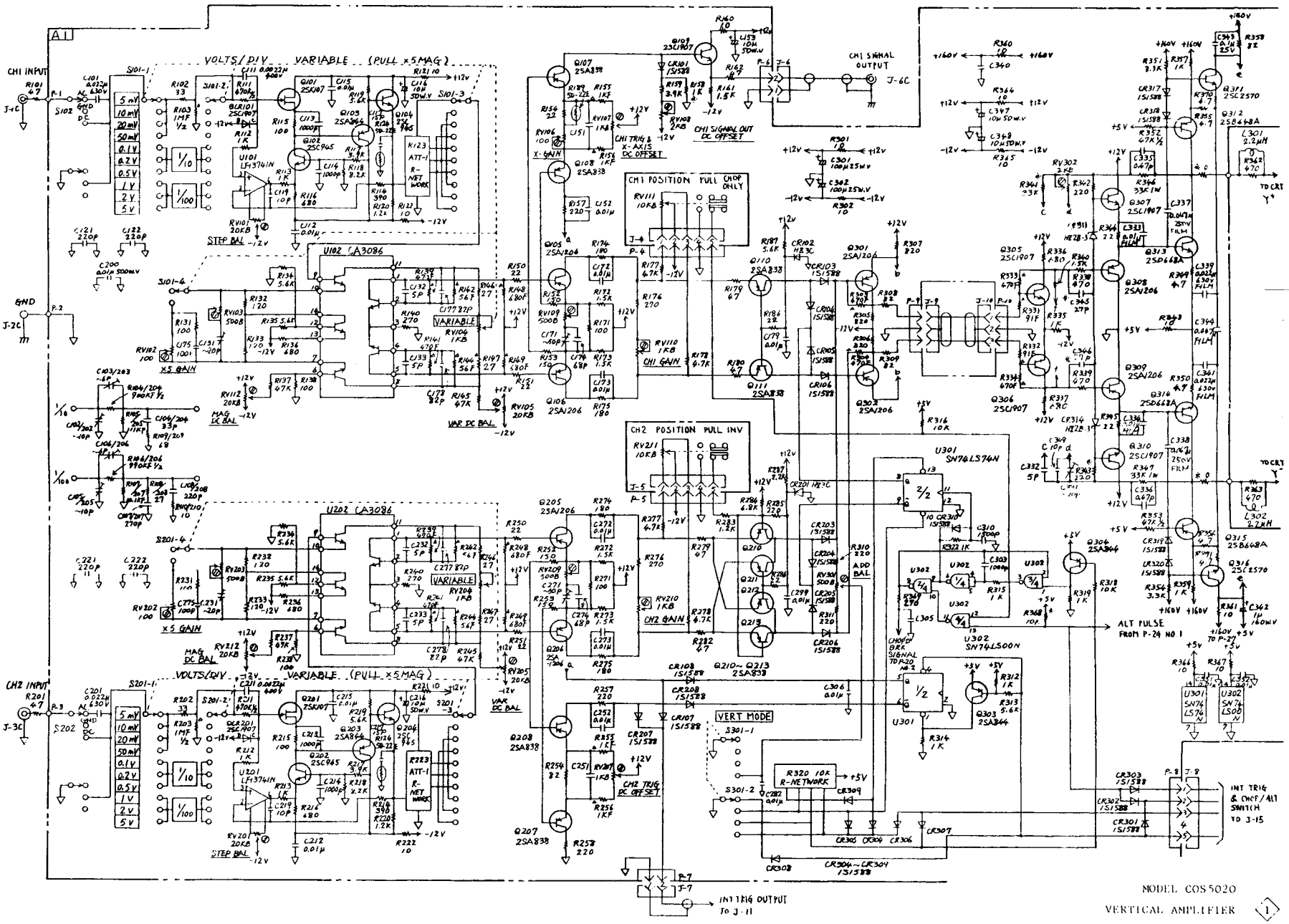
Figure 6-6



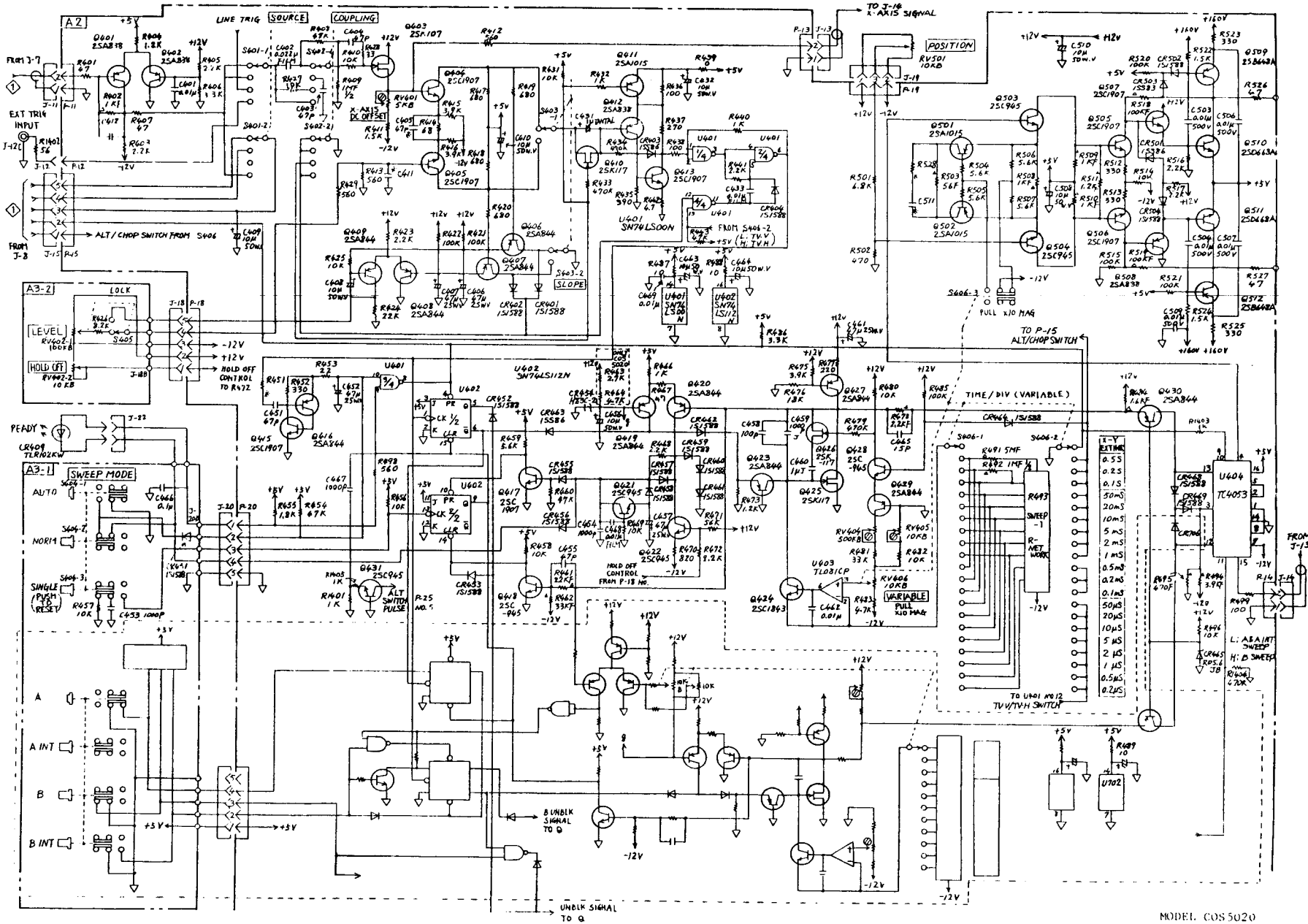




BLOCK DIAGRAM

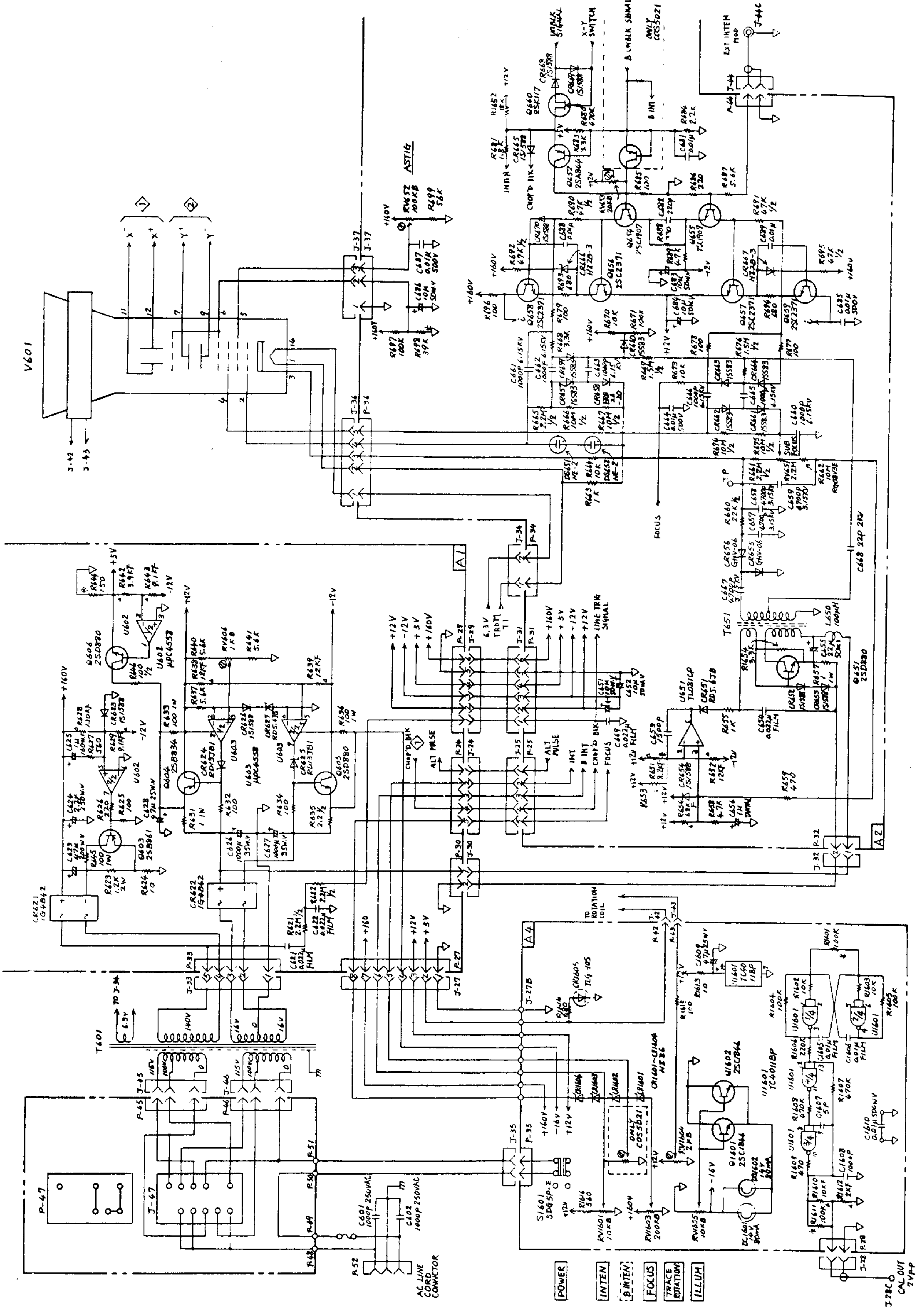


For Service Manuals Contact
MAURITRON TECHNICAL SERVICES
8 Cherry Tree Rd, Chinnor
Oxon OX9 4QY
Tel:- 01844-351694 Fax:- 01844-352554
Email:- enquiries@mauritron.co.uk



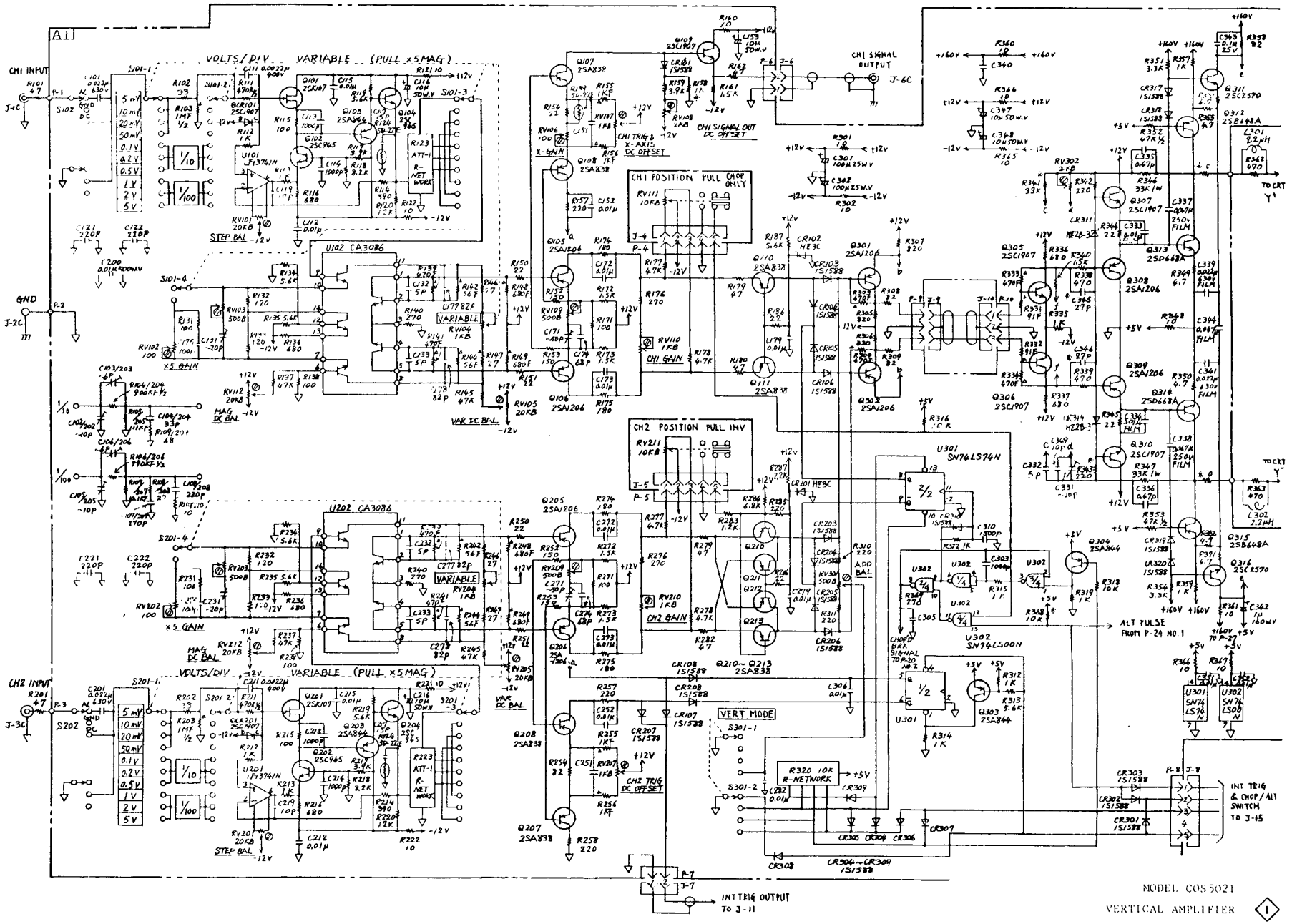
MODEL COS5020

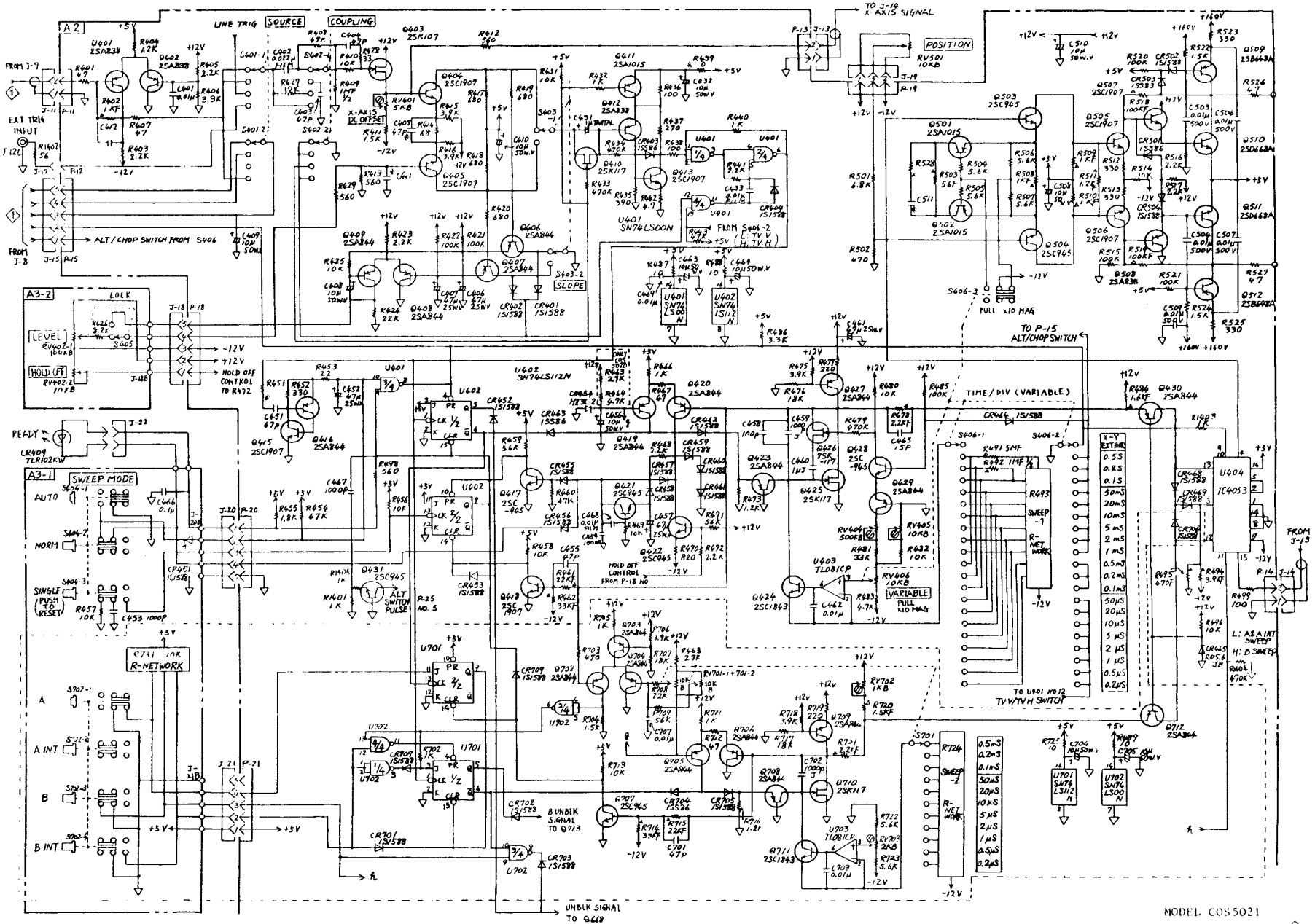
TRIG & SWEEP GENERATOR

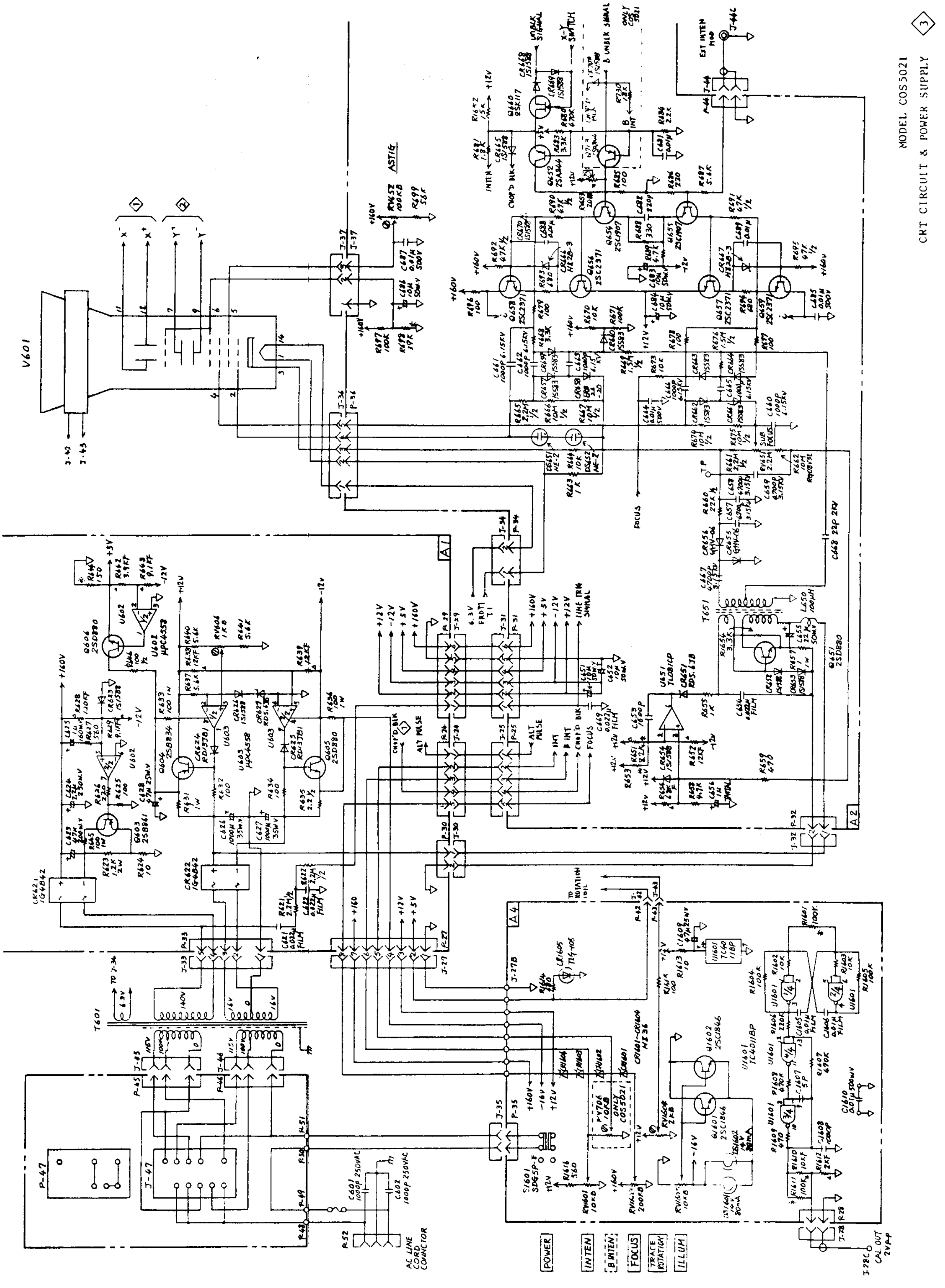


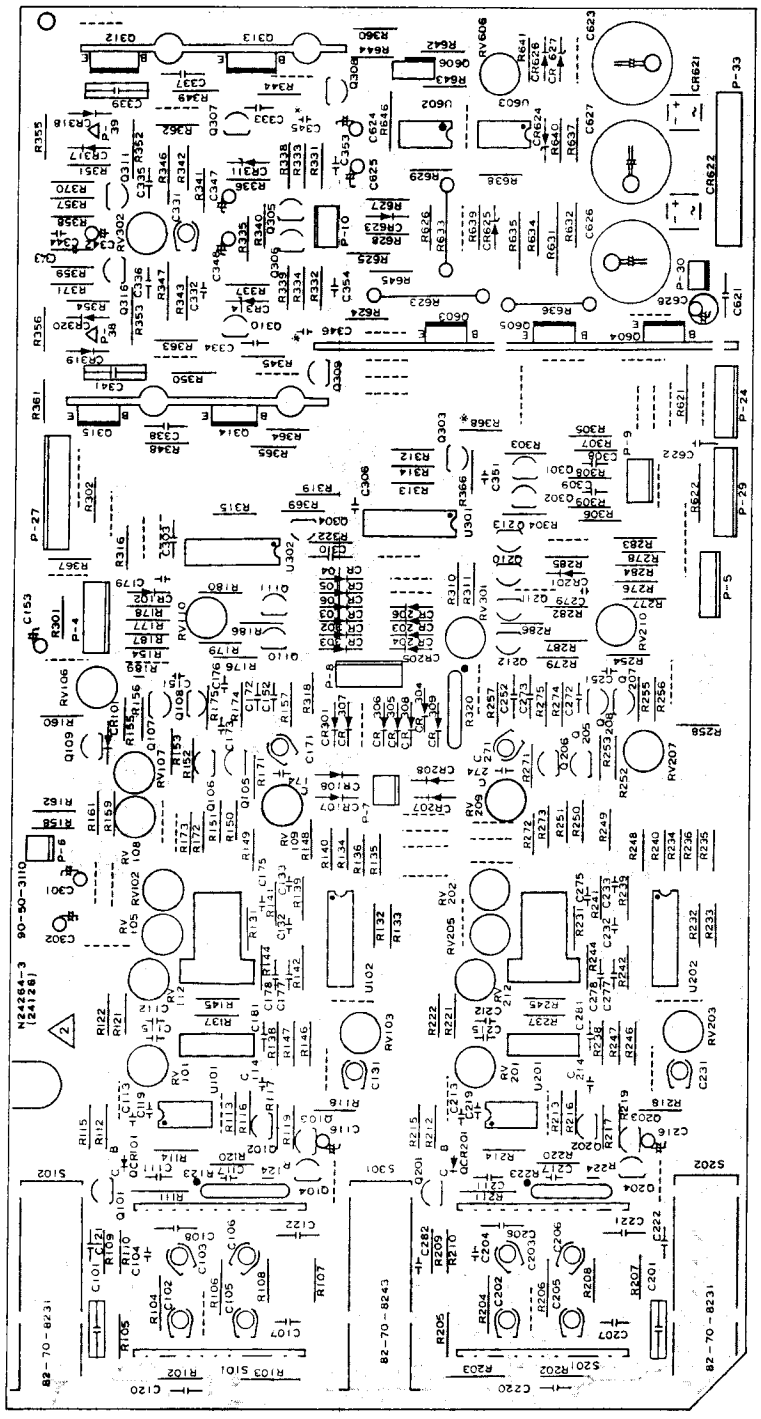
MODEL COS5020

CRT CIRCUIT & POWER SUPPLY


A11
CH1 INPUT
VOLTS/DIV VARIABLE (PULL x5MAG)
5 mV
10 mV
20 mV
50 mV
0.1 V
0.2 V
0.5 V
1 V
2 V
5 V
STEP BAL
MAG DC BAL
x5 GAIN
VAR DC BAL
CH1 POSITION PULL CHOP ONLY
CH1 GAIN
CH1 TRIG & X-AXIS DC OFFSET
CH1 SIGNAL OUT DC OFFSET
CH1 SIGNAL OUTPUT
CH2 POSITION PULL INV
CH2 GAIN
ADD BAL
CH2 INPUT
VERT MODE
CH2 TRIG DC OFFSET
INT TRIG OUTPUT
TO J-11
ALT PULSE
From P-24 NO.1
CHOP BRK SIGNAL TO P-20 NO.2
INT TRIG & CHOP/ALT SWITCH TO J-15
TO CRT Y+
TO CRT Y-
MODEL COS 5021
VERTICAL AMPLIFIER
1

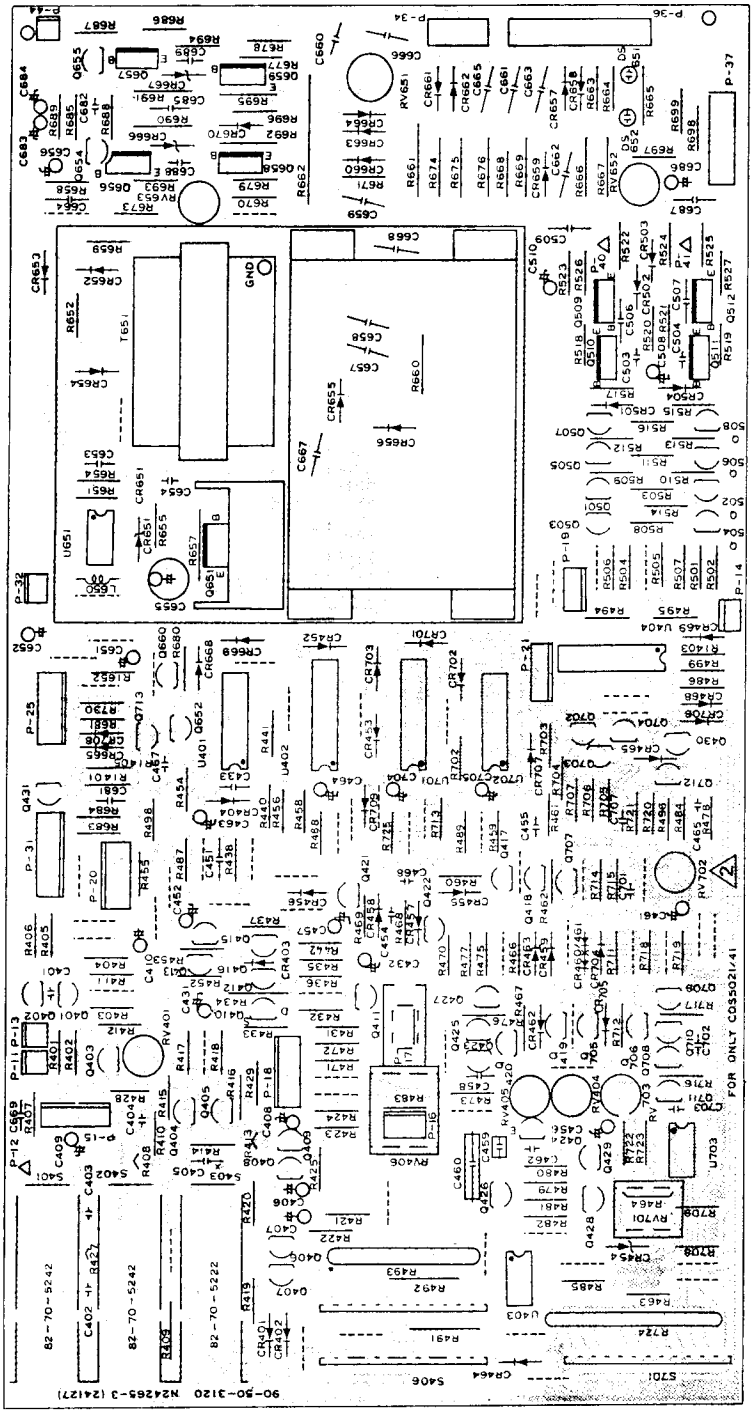

A2
LINE TRIG
SOURCE
COUPLING
EXT TRIG INPUT
X-AXIS DC OFFSET
SLOPE
POSITION
TO J-14 X AXIS SIGNAL
ALT/CHOP SWITCH FROM S406
PULL X10 MAG
TO P-15 ALT/CHOP SWITCH
A3-2
LOCK
LEVEL
HOLD OFF
HOLD OFF CONTROL TO R472
A3-1
SWEEP MODE
AUTO
NORM
SINGLE (PUSH TO RESET)
R-NETWORK
A
A INT
B
B INT
PEADY
TIME/DIV (VARIABLE)
VARIABLE
PULL X10 MAG
TO U401 #12 TV/TVH SWITCH
B UNBLK SIGNAL TO Q713
UNBLK SIGNAL TO Q668
FROM J-13
L: A & A INT SWEEP
H: B SWEEP
U401 SN74LS00N
U402 SN74LS112N
U403 TL081CP
U404 TC4053
MODEL COS5021
TRIG & SWEEP GENERATOR
2





Vert Amp & Power Supply Al Parts Location Diagram (Parts Side View)

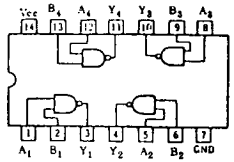
For Service Manuals Contact
MAURITRON TECHNICAL SERVICES
8 Cherry Tree Rd, Chinnor
Oxon OX9 4QY
Tel:- 01844-351694 Fax:- 01844-352554
Email:- enquiries@mauritron.co.uk



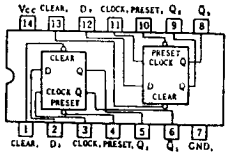
Sweep & H.V. A2 Parts Location Diagram

(Parts Side View)

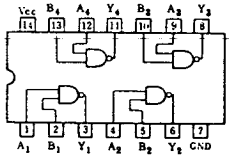
DIGITAL & ANALOG ICs



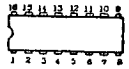
(TOP VIEW)
TC4011BP



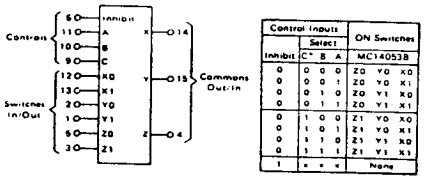
(TOP VIEW)
SN74LS74N



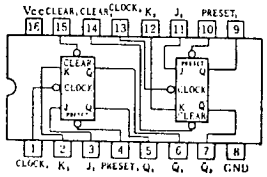
(TOP VIEW)
SN74LS00N



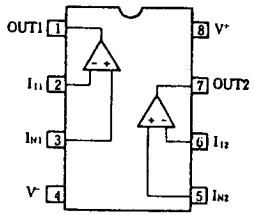
(TOP VIEW)



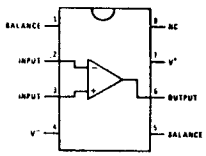
TC4053BP



(TOP VIEW)
SN74LS112N

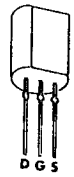


(TOP VIEW)
μPC4558C



(TOP VIEW)
LF13741N
TL081CP

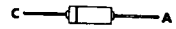
FET



2SK107-3
2SK117-BL

DIODE

GHV-06SSN
ERB26-20

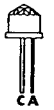


1S1588

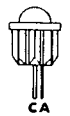
1SS83 HZ2B RD5.6JB
1SS86 HZ3C RD13JB
HZ36L

1G4B42

LED

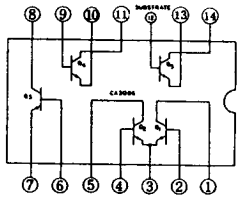


TLG-105



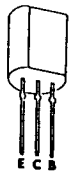
TLR102KW

TRANSISTOR ARRAY

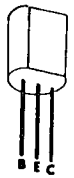


CA3086

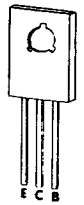
TRANSISTOR



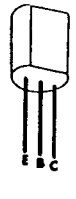
2SA844-D
2SC1907



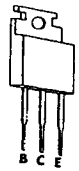
2SC2570



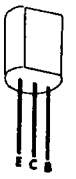
2SA1144-O
2SB648A
2SC1846-R
2SC2371-L
2SC2704-O
2SD668A



2SA1206-L



2SB834-Y
2SB861-C
2SD880-Y



2SA838-B
2SA1015-Y
2SC945-Q
2SC1843E

SEMICONDUCTOR LEAD CONFIGURATION

For Service Manuals Contact
MAURITRON TECHNICAL SERVICES
8 Cherry Tree Rd, Chinnor
Oxon OX9 4QY
Tel:- 01844-351694 Fax:- 01844-352554
Email:- enquiries@mauritron.co.uk

REPLACEABLE PARTS
FOR COS5020

ABBREVIATIONS

CER:	CERAMIC
C FILM:	CARBON FILM
C COMP:	CARBON COMPOSITION
CRT:	CATHODE RAY TUBE
ELECT:	ELECTROLYTIC
FET:	FIELD EFFECT TRANSISTOR
FXD:	FIXED
LED:	LIGHT EMITTING DIODE
M FILM:	METAL FILM
M GLAZE:	METAL GLAZE
M OX:	METAL OXIDE
M PLSTC FILM:	METALLIZED PLASTIC FILM
PLSTC FILM:	PLASTIC FILM
Si:	SILICON
TANT ELECT:	TANTALUM ELECTROLYTIC
VAR:	VARIABLE
WW:	WIREWOUND
*:	OPTIMUM VALUE SELECTED AT FACTORY. AVERAGE VALUE SHOWN. (PART MAY BE OMITTED.)

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION	
A1	ASSEMBLY		
CR101	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR102	32-92-0033	ZENER VZ=3.2-3.4V	HITACHI HZ3C-2
CR103	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR104	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR105	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR106	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR107	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR108	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR201	32-92-0033	ZENER VZ=3.2-3.4V	HITACHI HZ3C-2
CR203	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR204	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR205	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR206	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR207	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR208	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR301	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR302	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR303	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR304	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR305	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR306	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR307	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR308	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR309	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR310	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR311	32-92-0022	ZENER VZ=2.1-2.3V	HITACHI HZ2B-3
CR314	32-92-0022	ZENER VZ=2.1-2.3V	HITACHI HZ2B-3
CR317	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR318	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR319	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR320	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR621	32-90-2110	DIODE BRIDGE VRM=400V IO=1A	TOSHIBA 1G4B42
CR622	32-90-2110	DIODE BRIDGE VRM=400V IO=1A	TOSHIBA 1G4B42
CR623	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR624	32-92-0130	ZENER VZ=12.41-13.05V P=0.4W	NEC RD13J
CR625	32-92-0130	ZENER VZ=12.41-13.05V P=0.4W	NEC RD13J
CR626	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR627	32-92-0056	ZENER VZ=5.5-5.8V P=0.4W	NEC RD5.6J
CR670	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
Q101	31-20-1073	FET	SONY 2SK107-3
Q102	30-30-9451	TR SI NPN	NEC 2SC945-Q
Q103	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q104	30-30-9451	TR SI NPN	NEC 2SC945-Q
Q105	30-11-2061	TR SI PNP	NEC 2SA1206-L
Q106	30-11-2061	TR SI PNP	NEC 2SA1206-L
Q107	30-10-8381	TR SI PNP	MATSUSHITA 2SA838-B
Q108	30-10-8381	TR SI PNP	MATSUSHITA 2SA838-B
Q109	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q110	30-10-8381	TR SI PNP	MATSUSHITA 2SA838-B
Q111	30-10-8381	TR SI PNP	MATSUSHITA 2SA838-B
Q201	31-20-1073	FET	SONY 2SK107-3
Q202	30-30-9451	TR SI NPN	NEC 2SC945-Q
Q203	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q204	30-30-9451	TR SI NPN	NEC 2SC945-Q
Q205	30-11-2061	TR SI PNP	NEC 2SA1206-L
Q206	30-11-2061	TR SI PNP	NEC 2SA1206-L
Q207	30-10-8381	TR SI PNP	MATSUSHITA 2SA838-B
Q208	30-10-8381	TR SI PNP	MATSUSHITA 2SA838-B
Q210	30-10-8381	TR SI PNP	MATSUSHITA 2SA838-B
Q211	30-10-8381	TR SI PNP	MATSUSHITA 2SA838-B
Q212	30-10-8381	TR SI PNP	MATSUSHITA 2SA838-B
Q213	30-10-8381	TR SI PNP	MATSUSHITA 2SA838-B
Q301	30-11-2061	TR SI PNP	NEC 2SA1206-L
Q302	30-11-2061	TR SI PNP	NEC 2SA1206-L
Q303	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q304	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q305	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q306	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q307	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q308	30-11-2061	TR SI PNP	NEC 2SA1206-L
Q309	30-11-2061	TR SI PNP	NEC 2SA1206-L
Q310	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q311	30-32-5700	TR SI NPN	NEC 2SC2570
Q312	30-20-6481	TR SI PNP	HITACHI 2SB648A
Q313	30-40-6681	TR SI NPN	HITACHI 2SD668A-C

REFERENCE DESIGNATOR		KIKUSUI PARTS NO.	DESCRIPTION	
Q314		30-40-6681	TR SI NPN	HITACHI 2SD668A-C
Q315		30-20-6481	TR SI PNP	HITACHI 2SB648A
Q316		30-32-5700	TR SI NPN	NEC 2SC2570
Q603		30-20-8611	TR SI PNP	HITACHI 2SB861-C
Q604		30-20-8341	TR SI PNP	TOSHIBA 2SB834-Y
Q605		30-40-8802	TR SI NPN	NEC 2SD880-Y
Q606		30-40-8802	TR SI NPN	NEC 2SD880-Y
QCR101		30-31-9071	TR SI NPN	HITACHI 2SC1907
QCR201		30-31-9071	TR SI NPN	HITACHI 2SC1907
U101		34-00-0121	FET OPEAMP	N.S LF13741N
U102		30-90-0141	TRANSISTOR ARRAYS 5 NPN	RCA CA3086
U201		34-00-0121	FET OPEAMP	N.S LF13741N
U202		30-90-0141	TRANSISTOR ARRAYS 5 NPN	RCA CA3086
U301		35-70-0741	DUAL D-FLIP FLOP	T.I SN74LS74N
U302		35-70-0001	QUAD 2-INPUT POSI-NAND	T.I SN74LS00N
U602		34-00-0240	DUAL OPEAMP	NEC UPC4558C
U603		34-00-0240	DUAL OPEAMP	NEC UPC4558C
R102		40-27-0332	FXD C FILM 33 OHM 5% 1/4W	
R103		42-74-5100	FXD M FILM 1M OHM 1% 1/2W	
R104		42-74-4900	FXD M FILM 900K OHM 1% 1/2W	
R105		42-72-4111	FXD M FILM 111K OHM 1% 1/4W	
R106		42-74-4990	FXD M FILM 990K OHM 1% 1/2W	
R107		42-72-3101	FXD M FILM 10.1K OHM 1% 1/4W	
R108		40-27-0222	FXD C FILM 22 OHM 5% 1/4W	
R109		40-27-0682	FXD C FILM 68 OHM 5% 1/4W	
R110		40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R111		40-37-4471	FXD C FILM 470K OHM 5% 1/2W	
R112		40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R113		40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R114		40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R115		40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R116		40-27-1682	FXD C FILM 680 OHM 5% 1/4W	
R117		40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W	
R118		40-27-2822	FXD C FILM 8.2K OHM 5% 1/4W	
R119		40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R120		40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W	
R121		40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R122		40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R123		44-04-0000	FXD M GLAZE R-NETWORK	KIKUSUI S8109001
R124		38-00-0000	THERMISTER 250 OHM	
R131		40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R132		40-27-1122	FXD C FILM 120 OHM 5% 1/4W	
R133		40-27-1122	FXD C FILM 120 OHM 5% 1/4W	
R134		40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R135		40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R136		40-27-1682	FXD C FILM 680 OHM 5% 1/4W	
R137		40-27-3472	FXD C FILM 47K OHM 5% 1/4W	
R138		40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R139		42-72-1470	FXD M FILM 470 OHM 1% 1/4W	
R140		40-27-1272	FXD C FILM 270 OHM 5% 1/4W	
R141		42-72-1470	FXD M FILM 470 OHM 1% 1/4W	
R142		42-72-0560	FXD M FILM 56 OHM 1% 1/4W	
R144		42-72-0560	FXD M FILM 56 OHM 1% 1/4W	
R145		40-27-3472	FXD C FILM 47K OHM 5% 1/4W	
R146		40-27-0272	FXD C FILM 27 OHM 5% 1/4W	
R147		40-27-0272	FXD C FILM 27 OHM 5% 1/4W	
R148		42-72-1680	FXD M FILM 680 OHM 1% 1/4W	
R149		42-72-1680	FXD M FILM 680 OHM 1% 1/4W	
R150		40-27-0222	FXD C FILM 22 OHM 5% 1/4W	
R151		40-27-0222	FXD C FILM 22 OHM 5% 1/4W	
R152		40-27-1152	FXD C FILM 150 OHM 5% 1/4W	
R153		40-27-1152	FXD C FILM 150 OHM 5% 1/4W	
R154		40-27-0222	FXD C FILM 22 OHM 5% 1/4W	
R155		42-72-2100	FXD M FILM 1K OHM 1% 1/4W	
R156		42-72-2100	FXD M FILM 1K OHM 1% 1/4W	
R157		40-27-1222	FXD C FILM 220 OHM 5% 1/4W	
R158	*	40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R159		40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W	
R160		40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R161		40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W	
R162		40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R171		40-27-1122	FXD C FILM 120 OHM 5% 1/4W	
R172		40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W	
R173		40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W	

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION	
R174	40-27-1182	FXD C FILM 180 OHM 5% 1/4W	
R175	40-27-1182	FXD C FILM 180 OHM 5% 1/4W	
R176	40-27-1272	FXD C FILM 270 OHM 5% 1/4W	
R177	40-27-2472	FXD C FILM 4.7K OHM 5% 1/4W	
R178	40-27-2472	FXD C FILM 4.7K OHM 5% 1/4W	
R179	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R180	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R186	40-27-0222	FXD C FILM 22 OHM 5% 1/4W	
R187	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R189	38-00-0000	THERMISTER 250 OHM	
R202	40-27-0332	FXD C FILM 33 OHM 5% 1/4W	
R203	42-74-5100	FXD M FILM 1M OHM 1% 1/2W	
R204	42-74-4900	FXD M FILM 900K OHM 1% 1/2W	
R205	42-72-4111	FXD M FILM 111K OHM 1% 1/4W	
R206	42-74-4990	FXD M FILM 990K OHM 1% 1/2W	
R207	42-72-3101	FXD M FILM 10.1K OHM 1% 1/4W	
R208	40-27-0222	FXD C FILM 22 OHM 5% 1/4W	
R209	40-27-0682	FXD C FILM 68 OHM 5% 1/4W	
R210	40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R211	40-37-4471	FXD C FILM 470K OHM 5% 1/2W	
R212	40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R213	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R214	40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R215	40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R216	40-27-1682	FXD C FILM 680 OHM 5% 1/4W	
R217	40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W	
R218	40-27-2822	FXD C FILM 8.2K OHM 5% 1/4W	
R219	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R220	40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W	
R221	40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R222	40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R223	44-04-0000	FXD M GLAZE R-NETWORK	KIKUSUI S8109001
R231	40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R232	40-27-1122	FXD C FILM 120 OHM 5% 1/4W	
R233	40-27-1122	FXD C FILM 120 OHM 5% 1/4W	
R234	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R235	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R236	40-27-1682	FXD C FILM 680 OHM 5% 1/4W	
R237	40-27-3472	FXD C FILM 47K OHM 5% 1/4W	
R238	40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R239	42-72-1470	FXD M FILM 470 OHM 1% 1/4W	
R240	40-27-1272	FXD C FILM 270 OHM 5% 1/4W	
R241	42-72-1470	FXD M FILM 470 OHM 1% 1/4W	
R242	42-72-0560	FXD M FILM 56 OHM 1% 1/4W	
R244	42-72-0560	FXD M FILM 56 OHM 1% 1/4W	
R245	40-27-3472	FXD C FILM 47K OHM 5% 1/4W	
R246	40-27-0272	FXD C FILM 27 OHM 5% 1/4W	
R247	40-27-0272	FXD C FILM 27 OHM 5% 1/4W	
R248	42-72-1680	FXD M FILM 680 OHM 1% 1/4W	
R249	42-72-1680	FXD M FILM 680 OHM 1% 1/4W	
R250	40-27-0222	FXD C FILM 22 OHM 5% 1/4W	
R251	40-27-0222	FXD C FILM 22 OHM 5% 1/4W	
R252	40-27-1152	FXD C FILM 150 OHM 5% 1/4W	
R253	40-27-1152	FXD C FILM 150 OHM 5% 1/4W	
R254	40-27-0822	FXD C FILM 82 OHM 5% 1/4W	
R255	42-72-2100	FXD M FILM 1K OHM 1% 1/4W	
R256	42-72-2100	FXD M FILM 1K OHM 1% 1/4W	
R257	40-27-1222	FXD C FILM 220 OHM 5% 1/4W	
R258	40-27-1222	FXD C FILM 220 OHM 5% 1/4W	
R271	40-27-1122	FXD C FILM 120 OHM 5% 1/4W	
R272	40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W	
R273	40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W	
R274	40-27-1182	FXD C FILM 180 OHM 5% 1/4W	
R275	40-27-1182	FXD C FILM 180 OHM 5% 1/4W	
R276	40-27-1272	FXD C FILM 270 OHM 5% 1/4W	
R277	40-27-2472	FXD C FILM 4.7K OHM 5% 1/4W	
R278	40-27-2472	FXD C FILM 4.7K OHM 5% 1/4W	
R279	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R282	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R283	40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W	
R284	40-27-2682	FXD C FILM 6.8K OHM 5% 1/4W	
R285	40-27-1222	FXD C FILM 220 OHM 5% 1/4W	
R286	40-27-0222	FXD C FILM 22 OHM 5% 1/4W	
R287	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R301	40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R302	40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R303	42-72-1470	FXD M FILM 470 OHM 1% 1/4W	

REFERENCE DESIGNATOR		KIKUSUI PARTS NO.	DESCRIPTION
R304		42-72-1470	FXD M FILM 470 OHM 1% 1/4W
R305		40-27-1822	FXD C FILM 820 OHM 5% 1/4W
R306		40-27-1822	FXD C FILM 820 OHM 5% 1/4W
R307		40-27-1822	FXD C FILM 820 OHM 5% 1/4W
R308		40-27-0822	FXD C FILM 82 OHM 5% 1/4W
R309		40-27-0822	FXD C FILM 82 OHM 5% 1/4W
R310		40-27-1222	FXD C FILM 220 OHM 5% 1/4W
R311		40-27-1222	FXD C FILM 220 OHM 5% 1/4W
R312		40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R313		40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W
R314		40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R315		40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R316		40-27-3102	FXD C FILM 10K OHM 5% 1/4W
R318		40-27-3102	FXD C FILM 10K OHM 5% 1/4W
R319		40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R320		44-07-0020	FXD M GLAZE RESISTOR NETWORKS 10K OHM X4
R322		40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R331		42-72-0910	FXD M FILM 91 OHM 1% 1/4W
R332		42-72-0910	FXD M FILM 91 OHM 1% 1/4W
R333		42-72-1470	FXD M FILM 470 OHM 1% 1/4W
R334		42-72-1470	FXD M FILM 470 OHM 1% 1/4W
R335		40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R336		40-27-1682	FXD C FILM 680 OHM 5% 1/4W
R337		40-27-1682	FXD C FILM 680 OHM 5% 1/4W
R338		40-27-1472	FXD C FILM 470 OHM 5% 1/4W
R339		40-27-1472	FXD C FILM 470 OHM 5% 1/4W
R340		40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W
R341	*	40-27-3272	FXD C FILM 27K OHM 5% 1/4W
R342		40-27-1222	FXD C FILM 220 OHM 5% 1/4W
R343		40-27-1222	FXD C FILM 220 OHM 5% 1/4W
R344		40-27-0222	FXD C FILM 22 OHM 5% 1/4W
R345		40-27-0222	FXD C FILM 22 OHM 5% 1/4W
R346		44-91-3330	FXD M OXIDE 33K OHM 5% 1W
R347		44-91-3330	FXD M OXIDE 33K OHM 5% 1W
R348		40-27-0102	FXD C FILM 10 OHM 5% 1/4W
R349		40-27-8472	FXD C FILM 4.7 OHM 5% 1/4W
R350		40-27-8472	FXD C FILM 4.7 OHM 5% 1/4W
R351		40-27-2332	FXD C FILM 3.3K OHM 5% 1/4W
R352		40-37-3471	FXD C FILM 47K OHM 5% 1/2W
R353		40-37-3471	FXD C FILM 47K OHM 5% 1/2W
R354		40-27-2332	FXD C FILM 3.3K OHM 5% 1/4W
R355		40-27-8472	FXD C FILM 4.7 OHM 5% 1/4W
R356		40-27-8472	FXD C FILM 4.7 OHM 5% 1/4W
R357		40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R358		40-27-0822	FXD C FILM 82 OHM 5% 1/4W
R359		40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R360		40-27-0102	FXD C FILM 10 OHM 5% 1/4W
R361		40-27-0102	FXD C FILM 10 OHM 5% 1/4W
R362		40-27-1472	FXD C FILM 470 OHM 5% 1/4W
R363		40-27-1472	FXD C FILM 470 OHM 5% 1/4W
R364		40-27-0102	FXD C FILM 10 OHM 5% 1/4W
R365		40-27-0102	FXD C FILM 10 OHM 5% 1/4W
R366		40-27-0102	FXD C FILM 10 OHM 5% 1/4W
R367		40-27-0102	FXD C FILM 10 OHM 5% 1/4W
R368	*	40-27-3102	FXD C FILM 10K OHM 5% 1/4W
R369		40-27-1272	FXD C FILM 270 OHM 5% 1/4W
R370		40-27-8472	FXD C FILM 4.7 OHM 5% 1/4W
R371		40-27-8472	FXD C FILM 4.7 OHM 5% 1/4W
R621		40-37-5221	FXD C FILM 2.2M OHM 5% 1/2W
R622		40-37-5221	FXD C FILM 2.2M OHM 5% 1/2W
R623		44-92-2120	FXD M OXIDE 1.2K OHM 5% 2W
R624		40-27-0102	FXD C FILM 10 OHM 5% 1/4W
R625		40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R626		40-27-1222	FXD C FILM 220 OHM 5% 1/4W
R627		40-27-1562	FXD C FILM 560 OHM 5% 1/4W
R628		42-72-4120	FXD M FILM 120K OHM 1% 1/4W
R629		42-72-2910	FXD M FILM 9.1K OHM 1% 1/4W
R631		44-91-0010	FXD M OXIDE 1 OHM 5% 1W
R632		40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R633		44-91-1100	FXD M OXIDE 100 OHM 5% 1W
R634		40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R635		40-37-8222	FXD C FILM 2.2 OHM 5% 1/2W
R636		44-91-1100	FXD M OXIDE 100 OHM 5% 1W
R637		40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W
R638		42-72-3120	FXD M FILM 12K OHM 1% 1/4W
R639		42-72-3120	FXD M FILM 12K OHM 1% 1/4W
R640		40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W

REFERENCE DESIGNATOR		KIKUSUI PARTS NO.	DESCRIPTION
R641		40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W
R642		42-72-2390	FXD M FILM 3.9K OHM 1% 1/4W
R643		42-72-2910	FXD M FILM 9.1K OHM 1% 1/4W
R644	*	40-27-1152	FXD C FILM 150 OHM 5% 1/4W
R646		40-37-1101	FXD C FILM 100 OHM 5% 1/2W
RV101		48-33-3200	VAR M FILM 20K OHM
RV102		48-33-1100	VAR M FILM 100 OHM
RV103		48-33-1500	VAR M FILM 500 OHM
RV105		48-33-3200	VAR M FILM 20K OHM
RV106		48-33-1100	VAR M FILM 100 OHM
RV107		48-33-2100	VAR M FILM 1K OHM
RV108		48-33-2200	VAR M FILM 2K OHM
RV109		48-33-1500	VAR M FILM 500 OHM
RV110		48-33-2100	VAR M FILM 1K OHM
RV112		48-33-3200	VAR M FILM 20K OHM
RV201		48-33-3200	VAR M FILM 20K OHM
RV202		48-33-1100	VAR M FILM 100 OHM
RV203		48-33-1500	VAR M FILM 500 OHM
RV205		48-33-3200	VAR M FILM 20K OHM
RV207		48-33-2100	VAR M FILM 1K OHM
RV209		48-33-1500	VAR M FILM 500 OHM
RV210		48-33-2100	VAR M FILM 1K OHM
RV212		48-33-3200	VAR M FILM 20K OHM
RV301		48-33-1500	VAR M FILM 500 OHM
RV302		48-33-2200	VAR M FILM 2K OHM
RV604		48-33-2100	VAR M FILM 1K OHM
C101		50-96-3590	FXD PLSTC FILM 0.022UF 20% 630V
C102		57-10-1191	VAR CER 3-10PF
C103		57-10-1181	VAR CER 3-6PF
C104		52-06-3165	FXD CER 33PF 10% 500V TYPE1
C105		57-10-1191	VAR CER 3-10PF
C106		57-10-1181	VAR CER 3-6PF
C107		52-06-2265	FXD CER 220PF 10% 50V TYPE1
C108		52-06-2265	FXD CER 220PF 10% 50V TYPE1
C111		50-87-0510	FXD PLSTC FILM 2200PF 10% 400V
C112		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C113		52-01-3345	FXD CER 1000PF 10% 500V TYPE2
C114		52-01-3345	FXD CER 1000PF 10% 500V TYPE2
C115		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C116		54-00-0311	FXD ELECT 10UF 50V
C117		52-06-3125	FXD CER 15PF 10% 500V TYPE1
C119		52-06-3051	FXD CER 5PF 10% 500V TYPE1
C119		52-06-2225	FXD CER 100PF 10% 50V TYPE1
C121		52-06-2265	FXD CER 220PF 10% 50V TYPE1
C122		52-06-2265	FXD CER 220PF 10% 50V TYPE1
C131		57-10-1203	VAR CER 5-20PF
C132		52-06-3051	FXD CER 5PF 10% 500V TYPE1
C133		52-06-3051	FXD CER 5PF 10% 500V TYPE1
C151		-- --	
C152		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C153		54-00-0311	FXD ELECT 10UF 50V
C171		57-10-1223	VAR CER 8-50PF
C172		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C173		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C174		52-06-2225	FXD CER 100PF 10% 50V TYPE1
C175		52-06-2225	FXD CER 100PF 10% 50V TYPE1
C177		52-06-2215	FXD CER 82PF 10% 500V TYPE1
C178		52-06-2215	FXD CER 82PF 10% 500V TYPE1
C179		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C200		52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2
C201		50-96-3590	FXD PLSTC FILM 0.022UF 20% 630V
C202		57-10-1191	VAR CER 3-10PF
C203		57-10-1181	VAR CER 3-6PF
C204		52-06-3165	FXD CER 33PF 10% 500V TYPE1
C205		57-10-1191	VAR CER 3-10PF
C206		57-10-1181	VAR CER 3-6PF
C207		52-06-2265	FXD CER 220PF 10% 50V TYPE1
C208		52-06-2265	FXD CER 220PF 10% 50V TYPE1
C211		50-87-0510	FXD PLSTC FILM 2200PF 10% 400V
C212		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C213		52-01-3345	FXD CER 1000PF 10% 500V TYPE2
C214		52-01-3345	FXD CER 1000PF 10% 500V TYPE2
C215		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C216		54-00-0311	FXD ELECT 10UF 50V
C218		52-06-3051	FXD CER 5PF 10% 500V TYPE1

REFERENCE DESIGNATOR		KIKUSUI PARTS NO.	DESCRIPTION	
C219		52-06-2225	FXD CER 100PF 10% 50V TYPE1	
C221		52-06-2265	FXD CER 220PF 10% 50V TYPE1	
C222		52-06-2265	FXD CER 220PF 10% 50V TYPE1	
C231		57-10-1203	VAR CER 5-20PF	
C232		52-06-3051	FXD CER 5PF 10% 500V TYPE1	
C233		52-06-3051	FXD CER 5PF 10% 500V TYPE1	
C251		- -		
C252		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2	
C271		57-10-1223	VAR CER 8-50PF	
C272		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2	
C273		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2	
C274		52-06-2225	FXD CER 100PF 10% 50V TYPE1	
C275		52-06-2225	FXD CER 100PF 10% 50V TYPE1	
C277		52-06-2215	FXD CER 82PF 10% 500V TYPE1	
C278		52-06-2215	FXD CER 82PF 10% 500V TYPE1	
C279		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2	
C282		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2	
C301		54-00-0121	FXD ELECT 100UF 25V	
C302		54-00-0121	FXD ELECT 100UF 25V	
C303		52-01-3345	FXD CER 1000PF 10% 500V TYPE2	
C306		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2	
C310		52-01-3365	FXD CER 1500PF 10% 50V TYPE2	
C331		57-10-1203	VAR CER 5-20PF	
C332		52-06-3051	FXD CER 5PF 10% 500V TYPE1	
C333		50-45-0500	FXD PLSTC FILM 0.01MF 5% 50V	
C334		50-45-0500	FXD PLSTC FILM 0.01MF 5% 50V	
C335		52-96-1140	FXD COMP 0.47PF 10% 500V	
C336		52-96-1140	FXD COMP 0.47PF 10% 500V	
C337		50-77-3500	FXD PLSTC FILM 0.047UF 20% 250V	
C338		50-77-3500	FXD PLSTC FILM 0.047UF 20% 250V	
C339		50-96-3590	FXD PLSTC FILM 0.022UF 20% 630V	
C340		- -		
C341		50-96-3590	FXD PLSTC FILM 0.022UF 20% 630V	
C342		54-60-1550	FXD ELECT 1UF 160V	
C343		52-05-1498	FXD CER 0.1UF +80-20% 25V TYPE2	
C344		50-67-0050	FXD PLSTC FILM 0.047UF 10% 100V	
C345	*	52-06-3155	FXD CER 27PF 10% 500V TYPE1	
C346	*	52-06-3155	FXD CER 27PF 10% 500V TYPE1	
C347		54-00-0311	FXD ELECT 10UF 50V	
C348		54-00-0311	FXD ELECT 10UF 50V	
C349		52-06-3102	FXD CER 10PF 10% 500V TYPE1	
C351		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2	
C352		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2	
C621		50-67-0040	FXD PLSTC FILM 0.022UF 10% 100V	
C622		50-67-0040	FXD PLSTC FILM 0.022UF 10% 100V	
C623		54-60-1620	FXD ELECT 47UF 200V	
C624		54-70-1020	FXD ELECT 2.2UF 250V	
C625		54-60-1550	FXD ELECT 1UF 160V	
C626		54-00-0231	FXD ELECT 1000UF 35V	
C627		54-00-0231	FXD ELECT 1000UF 35V	
C628		54-00-0114	FXD ELECT 47UF 25V	
L301		67-10-0880	INDUCTOR 2.2UH 20%	
L302		67-10-0880	INDUCTOR 2.2UH 20%	
S101		80-98-0580	SW ROTARY WITH RV VOLT/DIV	ALPS S21P2YC
S102		82-70-8231	LEVER SWITCH	ALPS SLR823-1
S201		80-98-0580	SW ROTARY WITH RV VOLT/DIV	ALPS S21P2YC
S202		82-70-8231	LEVER SWITCH	ALPS SLR823-1
S301		82-70-8243	LEVER SWITCH	ALPS SLR824-3
A2 ASSEMBLY				
CR401		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR402		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR403		32-30-0860	DIODE VR=30V IO=30MA	HITACHI 1SS86
CR404		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR452		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR453		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR454		32-92-0033	ZENER VZ=3.2-3.4V	HITACHI HZ3C-2
CR455		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR456		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR457		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR458		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR459		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR460		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR461		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR462		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION	
CR463	32-30-0860	DIODE VR=30V IO=30MA	HITACHI 1SS86
CR464	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR465	32-92-0056	ZENER VZ=5.5-5.8V P=0.4W	NEC RD5.6J
CR468	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR469	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR501	32-30-0860	DIODE VR=30V IO=30MA	HITACHI 1SS86
CR502	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR503	32-30-0830	DIODE VR=250V IO=200MA	HITACHI 1SS83
CR504	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR651	32-92-0056	ZENER VZ=5.5-5.8V P=0.4W	NEC RD5.6J
CR652	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR653	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR654	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR655	32-90-1951	DIODE VR=6KV FAST RECOVERY	SANKEN GHV-06SSN
CR656	32-90-1951	DIODE VR=6KV FAST RECOVERY	SANKEN GHV-06SSN
CR657	32-30-0830	DIODE VR=250V IO=200MA	HITACHI 1SS83
CR658	32-90-1820	DIODE VR=2KV FAST RECOVERY	HITACHI ERB26-20
CR659	32-30-0830	DIODE VR=250V IO=200MA	HITACHI 1SS83
CR660	32-30-0830	DIODE VR=250V IO=200MA	HITACHI 1SS83
CR661	32-30-0830	DIODE VR=250V IO=200MA	HITACHI 1SS83
CR662	32-30-0830	DIODE VR=250V IO=200MA	HITACHI 1SS83
CR663	32-30-0830	DIODE VR=250V IO=200MA	HITACHI 1SS83
CR664	32-30-0830	DIODE VR=250V IO=200MA	HITACHI 1SS83
CR665	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR666	32-92-0022	ZENER VZ=2.1-2.3V	HITACHI HZ2B-3
CR667	32-92-0022	ZENER VZ=2.1-2.3V	HITACHI HZ2B-3
CR668	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR669	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
Q401	30-10-8381	TR SI PNP	MATSUSHITA 2SA838-B
Q402	30-10-8381	TR SI PNP	MATSUSHITA 2SA838-B
Q403	31-20-1073	FET	SONY 2SK107-3
Q404	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q405	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q406	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q407	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q408	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q409	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q410	31-20-1171	FET	TOSHIBA 2SK117-BL
Q411	30-11-0151	TR SI PNP	TOSHIBA 2SA1015-Y
Q412	30-10-8381	TR SI PNP	MATSUSHITA 2SA838-B
Q413	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q415	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q416	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q417	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q418	30-30-9451	TR SI NPN	NEC 2SC945-Q
Q419	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q420	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q421	30-30-9451	TR SI NPN	NEC 2SC945-Q
Q422	30-30-9451	TR SI NPN	NEC 2SC945-Q
Q423	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q424	30-31-8431	TR SI NPN	NEC 2SC1843-E
Q425	31-20-1171	FET	TOSHIBA 2SK117-BL
Q426	31-20-1171	FET	TOSHIBA 2SK117-BL
Q427	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q428	30-30-9451	TR SI NPN	NEC 2SC945-Q
Q429	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q430	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q431	30-30-9451	TR SI NPN	NEC 2SC945-Q
Q501	30-11-0151	TR SI PNP	TOSHIBA 2SA1015-Y
Q502	30-11-0151	TR SI PNP	TOSHIBA 2SA1015-Y
Q503	30-30-9451	TR SI NPN	NEC 2SC945-Q
Q504	30-30-9451	TR SI NPN	NEC 2SC945-Q
Q505	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q506	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q507	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q508	30-10-8381	TR SI PNP	MATSUSHITA 2SA838-B
Q509	30-20-6481	TR SI PNP	HITACHI 2SB648A
Q510	30-40-6681	TR SI NPN	HITACHI 2SD668A-C
Q511	30-40-6681	TR SI NPN	HITACHI 2SD668A-C
Q512	30-20-6481	TR SI PNP	HITACHI 2SB648A
Q651	30-40-8802	TR SI NPN	NEC 2SD880-Y
Q652	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q654	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q655	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q656	30-32-3710	TR SI NPN	NEC 2SC2371-L
Q657	30-32-3710	TR SI NPN	NEC 2SC2371-L

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION	
Q658	30-32-3710	TR SI NPN	NEC 2SC2371-L
Q659	30-32-3710	TR SI NPN	NEC 2SC2371-L
Q660	31-20-1171	FET	TOSHIBA 2SK117-BL
U401	35-70-0001	QUAD 2-INPUT POSI-NAND	T.I SN74LS00N
U402	35-70-1121	DUAL J-K F-F	T.I SN74LS112N
U403	34-00-0215	J-FET INPUT OPEAMP	N.S LF13741N
U404	34-69-0030	TRIPLE 2-CHANNEL MULTIPLEXER	TOSHIBA TC4053BP
U651	34-00-0215	J-FET INPUT OPEAMP	N.S LF13741N
R401	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R402	42-72-2100	FXD M FILM 1K OHM 1% 1/4W	
R403	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R404	40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W	
R405	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R406	40-27-2332	FXD C FILM 3.3K OHM 5% 1/4W	
R407	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R408	40-27-3472	FXD C FILM 47K OHM 5% 1/4W	
R409	42-74-5100	FXD M FILM 1M OHM 1% 1/2W	
R410	40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R411	40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W	
R412	40-27-1562	FXD C FILM 560 OHM 5% 1/4W	
R413	40-27-1562	FXD C FILM 560 OHM 5% 1/4W	
R414	40-27-0682	FXD C FILM 68 OHM 5% 1/4W	
R415	40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W	
R416	40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W	
R417	40-27-1682	FXD C FILM 680 OHM 5% 1/4W	
R418	40-27-1682	FXD C FILM 680 OHM 5% 1/4W	
R419	40-27-1682	FXD C FILM 680 OHM 5% 1/4W	
R420	40-27-1682	FXD C FILM 680 OHM 5% 1/4W	
R421	40-27-4102	FXD C FILM 100K OHM 5% 1/4W	
R422	40-27-4102	FXD C FILM 100K OHM 5% 1/4W	
R423	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R424	40-27-3222	FXD C FILM 22K OHM 5% 1/4W	
R425	40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R427	40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R428	40-27-0332	FXD C FILM 33 OHM 5% 1/4W	
R429	40-27-1562	FXD C FILM 560 OHM 5% 1/4W	
R431	40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R432	40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R433	40-27-4472	FXD C FILM 470K OHM 5% 1/4W	
R434	40-27-4472	FXD C FILM 470K OHM 5% 1/4W	
R435	40-27-1392	FXD C FILM 390 OHM 5% 1/4W	
R436	40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R437	40-27-1272	FXD C FILM 270 OHM 5% 1/4W	
R438	40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R440	40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R441	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R442	40-27-8472	FXD C FILM 4.7 OHM 5% 1/4W	
R443	40-27-3472	FXD C FILM 47K OHM 5% 1/4W	
R451	— —		
R452	40-27-1332	FXD C FILM 330 OHM 5% 1/4W	
R453	40-27-0222	FXD C FILM 22 OHM 5% 1/4W	
R454	40-27-3472	FXD C FILM 47K OHM 5% 1/4W	
R455	40-27-2182	FXD C FILM 1.8K OHM 5% 1/4W	
R456	40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R458	40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R459	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R460	40-27-3472	FXD C FILM 47K OHM 5% 1/4W	
R461	42-72-3220	FXD M FILM 22K OHM 1% 1/4W	
R462	42-72-3330	FXD M FILM 33K OHM 1% 1/4W	
R463	40-27-2272	FXD C FILM 2.7K OHM 5% 1/4W	
R464	40-27-2472	FXD C FILM 4.7K OHM 5% 1/4W	
R466	40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R467	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R468	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R469	40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R470	40-27-1822	FXD C FILM 820 OHM 5% 1/4W	
R471	40-27-3562	FXD C FILM 56K OHM 5% 1/4W	
R472	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R473	40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W	
R474 *	— —		
R475	40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W	
R476	40-27-3182	FXD C FILM 18K OHM 5% 1/4W	
R477	40-27-1222	FXD C FILM 220 OHM 5% 1/4W	
R478	42-72-2220	FXD M FILM 2.2K OHM 1% 1/4W	
R479	40-27-4472	FXD C FILM 470K OHM 5% 1/4W	

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION
R480	40-27-3102	FXD C FILM 10K OHM 5% 1/4W
R481	40-27-3332	FXD C FILM 33K OHM 5% 1/4W
R482	40-27-3102	FXD C FILM 10K OHM 5% 1/4W
R483	40-27-2472	FXD C FILM 4.7K OHM 5% 1/4W
R484	42-72-2160	FXD M FILM 1.6K OHM 1% 1/4W
R485	40-27-4102	FXD C FILM 100K OHM 5% 1/4W
R486	40-27-2332	FXD C FILM 3.3K OHM 5% 1/4W
R487	40-27-0102	FXD C FILM 10 OHM 5% 1/4W
R488	40-27-0102	FXD C FILM 10 OHM 5% 1/4W
R489	40-27-0102	FXD C FILM 10 OHM 5% 1/4W
R491	42-24-0231	FXD M GLAZE 5M OHM 1% 0.3W
R492	42-74-5100	FXD M FILM 1M OHM 1% 1/2W
R493	44-04-0010	FXD M GLAZE R-NETWORK KIKUSUI S8109011
R494	42-72-2390	FXD M FILM 3.9K OHM 1% 1/4W
R495	42-72-1470	FXD M FILM 470 OHM 1% 1/4W
R496	40-27-3102	FXD C FILM 10K OHM 5% 1/4W
R498	40-27-1562	FXD C FILM 560 OHM 5% 1/4W
R499	40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R501	40-27-2682	FXD C FILM 6.8K OHM 5% 1/4W
R502	40-27-1472	FXD C FILM 470 OHM 5% 1/4W
R503	42-72-0560	FXD M FILM 56 OHM 1% 1/4W
R504	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W
R505	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W
R506	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W
R507	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W
R508	42-72-2100	FXD M FILM 1K OHM 1% 1/4W
R509	42-72-2100	FXD M FILM 1K OHM 1% 1/4W
R510	42-72-2100	FXD M FILM 1K OHM 1% 1/4W
R511	42-72-2120	FXD M FILM 1.2K OHM 1% 1/4W
R512	40-27-1332	FXD C FILM 330 OHM 5% 1/4W
R513	40-27-1332	FXD C FILM 330 OHM 5% 1/4W
R514	40-27-3102	FXD C FILM 10K OHM 5% 1/4W
R515	40-27-4102	FXD C FILM 100K OHM 5% 1/4W
R516	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W
R517	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W
R518	42-72-4100	FXD M FILM 100K OHM 1% 1/4W
R519	42-72-4100	FXD M FILM 100K OHM 1% 1/4W
R520	40-27-4102	FXD C FILM 100K OHM 5% 1/4W
R521	40-27-4102	FXD C FILM 100K OHM 5% 1/4W
R522	40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W
R523	40-27-1332	FXD C FILM 330 OHM 5% 1/4W
R524	40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W
R525	40-27-1332	FXD C FILM 330 OHM 5% 1/4W
R526	40-27-0472	FXD C FILM 47 OHM 5% 1/4W
R527	40-27-0472	FXD C FILM 47 OHM 5% 1/4W
* R528	— —	
R651	42-72-2820	FXD M FILM 8.2K OHM 1% 1/4W
R652	42-72-3120	FXD M FILM 12K OHM 1% 1/4W
* R653	— —	
R654	42-72-3680	FXD M FILM 68K OHM 1% 1/4W
R655	40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R657	44-91-0010	FXD M OXIDE 1 OHM 5% 1W
R658	40-27-2472	FXD C FILM 4.7K OHM 5% 1/4W
R659	40-27-1472	FXD C FILM 470 OHM 5% 1/4W
R660	40-37-3221	FXD C FILM 22K OHM 5% 1/2W
R661	40-37-5221	FXD C FILM 2.2M OHM 5% 1/2W
R662	42-44-0300	FXD M GLAZE 10M OHM 1% 2.5W
R663	40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R664	40-27-3102	FXD C FILM 10K OHM 5% 1/4W
R665	40-37-5221	FXD C FILM 2.2M OHM 5% 1/2W
R666	40-37-6101	FXD C FILM 10M OHM 5% 1/2W
R667	40-37-6101	FXD C FILM 10M OHM 5% 1/2W
R668	40-27-2332	FXD C FILM 3.3K OHM 5% 1/4W
R669	40-37-5151	FXD C FILM 1.5M OHM 5% 1/2W
R670	40-27-3102	FXD C FILM 10K OHM 5% 1/4W
R671	40-27-4102	FXD C FILM 100K OHM 5% 1/4W
R673	40-27-3102	FXD C FILM 10K OHM 5% 1/4W
R674	40-37-6101	FXD C FILM 10M OHM 5% 1/2W
R675	40-37-6101	FXD C FILM 10M OHM 5% 1/2W
R676	40-37-5151	FXD C FILM 1.5M OHM 5% 1/2W
R677	40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R678	40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R679	40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R680	40-27-4472	FXD C FILM 470K OHM 5% 1/4W
R681	40-27-2182	FXD C FILM 1.8K OHM 5% 1/4W
R683	40-27-2332	FXD C FILM 3.3K OHM 5% 1/4W
R684	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W

REFERENCE DESIGNATOR		KIKUSUI PARTS NO.	DESCRIPTION
R685		40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R686		40-27-1222	FXD C FILM 220 OHM 5% 1/4W
R687		40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W
R688		40-27-1332	FXD C FILM 330 OHM 5% 1/4W
R689		40-27-2472	FXD C FILM 4.7K OHM 5% 1/4W
R690		40-37-3471	FXD C FILM 47K OHM 5% 1/2W
R691		40-37-3471	FXD C FILM 47K OHM 5% 1/2W
R692		40-37-3471	FXD C FILM 47K OHM 5% 1/2W
R693		40-27-1682	FXD C FILM 680 OHM 5% 1/4W
R694		40-27-1682	FXD C FILM 680 OHM 5% 1/4W
R695		40-37-3471	FXD C FILM 47K OHM 5% 1/2W
R696		40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R697		40-27-4102	FXD C FILM 100K OHM 5% 1/4W
R698	*	40-27-3392	FXD C FILM 39K OHM 5% 1/4W
R699		40-27-3562	FXD C FILM 56K OHM 5% 1/4W
R1401		40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R1403		40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R1404		40-27-4472	FXD C FILM 470K OHM 5% 1/4W
R1405		40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R1652		40-27-3182	FXD C FILM 18K OHM 5% 1/4W
R1654		40-27-2332	FXD C FILM 3.3K OHM 5% 1/4W
RV401		48-33-2500	VAR M FILM 5K OHM
RV404		48-33-4500	VAR M FILM 500K OHM
RV405		48-33-3100	VAR M FILM 10K OHM
RV651		48-26-5220	VAR M GLAZE 2.2M OHM
RV652		48-33-4100	VAR M FILM 100K OHM
V653		48-33-3200	VAR M FILM 20K OHM
C401		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C402		50-67-0040	FXD PLSTC FILM 0.022UF 10% 100V
C403		52-06-3185	FXD CER 47PF 10% 500V TYPE1
C404		52-06-3185	FXD CER 47PF 10% 500V TYPE1
C405	*	52-06-3185	FXD CER 47PF 10% 500V TYPE1
C406		54-00-0114	FXD ELECT 47UF 25V
C407		54-00-0114	FXD ELECT 47UF 25V
C408		54-00-0311	FXD ELECT 10UF 50V
C409		54-00-0311	FXD ELECT 10UF 50V
C410		54-00-0311	FXD ELECT 10UF 50V
C411	*	- -	
C431		55-37-2050	FXD TANT ELECT 1UF 35V
C432		54-00-0311	FXD ELECT 10UF 50V
C433		50-67-0030	FXD PLSTC FILM 0.01UF 10% 100V
C451		52-06-3185	FXD CER 47PF 10% 500V TYPE1
C452		54-00-0114	FXD ELECT 47UF 25V
C454		52-01-3345	FXD CER 1000PF 10% 500V TYPE2
C455		52-06-3185	FXD CER 47PF 10% 500V TYPE1
C456		54-00-0311	FXD ELECT 10UF 50V
C457		54-00-0114	FXD ELECT 47UF 25V
C458		52-06-2225	FXD CER 100PF 10% 50V TYPE1
C459		50-65-0530	FXD M PLSTC FILM 1000PF 5% 100V
C460		50-65-0540	FXD M PLSTC FILM 1UF 5% 100V
C461		54-00-0114	FXD ELECT 47UF 25V
C462		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C463		54-00-0311	FXD ELECT 10UF 50V
C464		54-00-0311	FXD ELECT 10UF 50V
C465		52-06-3125	FXD CER 15PF 10% 500V TYPE1
C467		52-01-3345	FXD CER 1000PF 10% 500V TYPE2
C468		50-67-0030	FXD PLSTC FILM 0.01UF 10% 100V
C469		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C503		52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2
C504		52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2
C506		52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2
C507		52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2
C508		54-00-0311	FXD ELECT 10UF 50V
C509		52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2
C510		54-00-0311	FXD ELECT 10UF 50V
C511	*	- -	
C651		54-00-0311	FXD ELECT 10UF 50V
C652		54-00-0311	FXD ELECT 10UF 50V
C653		52-01-3365	FXD CER 1500PF 10% 50V TYPE2
C654		50-67-0040	FXD PLSTC FILM 0.022UF 10% 100V
C655		54-00-0312	FXD ELECT 22UF 50V
C656		55-37-2050	FXD TANT ELECT 1UF 35V
C657		52-98-1000	FXD CER 4700PF +80-20% 3.15KV TYPE1
C658		52-98-1000	FXD CER 4700PF +80-20% 3.15KV TYPE1

REFERENCE DESIGNATOR		KIKUSUI PARTS NO.	DESCRIPTION	
C659		52-98-1000	FXD CER 4700PF +80-20% 3.15KV TYPE1	
C660		52-98-1010	FXD CER 1000PF +80-20% 6.3KV TYPE1	
C661		52-98-1010	FXD CER 1000PF +80-20% 6.3KV TYPE1	
C662		52-98-1010	FXD CER 1000PF +80-20% 6.3KV TYPE1	
C663		52-98-1010	FXD CER 1000PF +80-20% 6.3KV TYPE1	
C664		52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2	
C665		52-98-1010	FXD CER 1000PF +80-20% 6.3KV TYPE1	
C666		52-98-1010	FXD CER 1000PF +80-20% 6.3KV TYPE1	
C667		52-98-1000	FXD CER 4700PF +80-20% 3.15KV TYPE1	
C668		52-08-5145	FXD CER 22PF 10% 2KV TYPE1	
C669		50-67-0040	FXD PLSTC FILM 0.022UF 10% 100V	
C681		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2	
C682		52-06-2265	FXD CER 220PF 10% 50V TYPE1	
C683		54-00-0311	FXD ELECT 10UF 50V	
C684		54-00-0311	FXD ELECT 10UF 50V	
C685		52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2	
C686		54-00-0311	FXD ELECT 10UF 50V	
C687		52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2	
C688		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2	
C689		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2	
DS651		23-70-0000	LAMP NEON	
DS652		23-70-0000	LAMP NEON	
L650		67-10-0590	INDUCTOR 100UH 10%	
S401		82-70-5242	LEVER SWITCH	ALPS SLR524-2
S402		82-70-5242	LEVER SWITCH	ALPS SLR524-2
S403		82-70-5222	PUSH SWITCH	ALPS SLR522-2
S406		80-98-0470	SW ROTARY WITH RV SWEEP/DIV	ALPS S21P2421
T651		63-92-0130	CONVERTOR TRANS	KIKUSUI S810115
A4 ASSEMBLY				
CR1601		32-92-0360	ZENER VZ=35.3-36.8V	HITACHI HZ36L-2
CR1602		32-92-0360	ZENER VZ=35.3-36.8V	HITACHI HZ36L-2
CR1603		32-92-0360	ZENER VZ=35.3-36.8V	HITACHI HZ36L-2
CR1604		32-92-0360	ZENER VZ=35.3-36.8V	HITACHI HZ36L-2
CR1605		37-00-0060	LAMP LED GREEN	TOSHIBA TLG-105
Q1601		30-31-8461	TR SI NPN	MATSUSHITA 2SC1846-R
Q1602		30-31-8461	TR SI NPN	MATSUSHITA 2SC1846-R
U1601		35-60-0000	QUAD 2-INPUT NAND GATES	TOSHIBA TC4011BF
R1601	*	40-27-4102	FXD C FILM 100K OHM 5% 1/4W	
R1602		40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R1603		40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R1604		40-27-4102	FXD C FILM 100K OHM 5% 1/4W	
R1605		40-27-4102	FXD C FILM 100K OHM 5% 1/4W	
R1606		40-27-4222	FXD C FILM 220K OHM 5% 1/4W	
R1607		40-27-4472	FXD C FILM 470K OHM 5% 1/4W	
R1608		40-27-4472	FXD C FILM 470K OHM 5% 1/4W	
R1609		40-27-1472	FXD C FILM 470 OHM 5% 1/4W	
R1610		42-72-3100	FXD M FILM 10K OHM 1% 1/4W	
R1611	*	40-27-4102	FXD C FILM 100K OHM 5% 1/4W	
R1612		42-72-2200	FXD M FILM 2K OHM 1% 1/4W	
R1613		40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R1614		40-27-1682	FXD C FILM 680 OHM 5% 1/4W	
R1615		40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R1616		40-27-1562	FXD C FILM 560 OHM 5% 1/4W	
RV1601		45-44-3100	VAR C COMP 10K OHM	
RV1603		45-44-4200	VAR C COMP 200K OHM	
RV1604		45-43-2200	VAR M GLAZE 2K OHM	
RV1605		45-44-3100	VAR C COMP 10K OHM	
C1605		50-45-0500	FXD PLSTC FILM 0.01MF 5% 50V	
C1606		50-45-0500	FXD PLSTC FILM 0.01MF 5% 50V	
C1607		52-06-3051	FXD CER 5PF 10% 500V TYPE1	
C1608		52-01-3345	FXD CER 1000PF 10% 500V TYPE2	
C1609		54-00-0114	FXD ELECT 47UF 25V	
C1610		52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2	
DS1601		23-44-0000	LAMP 14V 80MA	
DS1602		23-44-0000	LAMP 14V 80MA	
B ASSEMBLY				
CR409		37-00-0082	LAMP LED RED	TOSHIBA TLR102KW

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION	
CR451	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
R101	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R201	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R426	40-27-2822	FXD C FILM 8.2K OHM 5% 1/4W	
R457	40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R1402	40-27-0562	FXD C FILM 56 OHM 5% 1/4W	
RV111	45-01-0700	VAR C COMP 10K OHM WITH SW	
RV211	45-01-0700	VAR C COMP 10K OHM WITH SW	
RV402	45-01-0550	VAR C COMP 10K/100K OHM B	
RV406	45-01-0690	VAR C COMP 10K OHM WITH SW	
RV501	45-35-3103	VAR C COMP 10K OHM	
C453	52-01-3345	FXD CER 1000PF 10% 500V TYPE2	
C466	52-05-1498	FXD CER 0.1UF +80-20% 25V TYPE2	
C601	52-77-1000	FXD CER 100PF 250VAC	
C602	52-77-1000	FXD CER 100PF 250VAC	
S404	81-03-0270	PUSH SWITCH	ALPS SUE30
S1601	81-01-0270	PUSH SWITCH	ALPS SDG5P-E
T601	60-44-0110	POWER TRANS	KIKUSUI S820041
V601	21-16-0601	CRT	TOSHIBA 150BTB31

REPLACEABLE PARTS
FOR COS5021

ABBREVIATIONS

CER:	CERAMIC
C FILM:	CARBON FILM
C COMP:	CARBON COMPOSITION
CRT:	CATHODE RAY TUBE
ELECT:	ELECTROLYTIC
FET:	FIELD EFFECT TRANSISTOR
FXD:	FIXED
LED:	LIGHT EMITTING DIODE
M FILM:	METAL FILM
M GLAZE:	METAL GLAZE
M OX:	METAL OXIDE
M PLSTC FILM:	METALLIZED PLASTIC FILM
PLSTC FILM:	PLASTIC FILM
Si:	SILICON
TANT ELECT:	TANTALUM ELECTROLYTIC
VAR:	VARIABLE
WW:	WIREWOUND
*:	OPTIMUM VALUE SELECTED AT FACTORY. AVERAGE VALUE SHOWN. (PART MAY BE OMITTED.)

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION	
A1 ASSEMBLY			
CR101	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR102	32-92-0033	ZENER VZ=3.2-3.4V	HITACHI HZ3C-2
CR103	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR104	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR105	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR106	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR107	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR108	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR201	32-92-0033	ZENER VZ=3.2-3.4V	HITACHI HZ3C-2
CR203	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR204	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR205	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR206	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR207	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR208	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR301	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR302	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR303	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR304	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR305	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR306	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR307	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR308	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR309	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR310	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR311	32-92-0022	ZENER VZ=2.1-2.3V	HITACHI HZ2B-3
CR314	32-92-0022	ZENER VZ=2.1-2.3V	HITACHI HZ2B-3
CR317	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR318	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR319	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR320	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR621	32-90-2110	DIODE BRIDGE VRM=400V IO=1A	TOSHIBA 1G4B42
CR622	32-90-2110	DIODE BRIDGE VRM=400V IO=1A	TOSHIBA 1G4B42
CR623	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR624	32-92-0130	ZENER VZ=12.41-13.05V P=0.4W	NEC RD13J
CR625	32-92-0130	ZENER VZ=12.41-13.05V P=0.4W	NEC RD13J
CR626	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR627	32-92-0056	ZENER VZ=5.5-5.8V P=0.4W	NEC RD5.6J
CR670	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
Q101	31-20-1073	FET	SONY 2SK107-3
Q102	30-30-9451	TR SI NPN	NEC 2SC945-Q
Q103	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q104	30-30-9451	TR SI NPN	NEC 2SC945-Q
Q105	30-11-2061	TR SI PNP	NEC 2SA1206-L
Q106	30-11-2061	TR SI PNP	NEC 2SA1206-L
Q107	30-10-8381	TR SI PNP	MATSUSHITA 2SA838-B
Q108	30-10-8381	TR SI PNP	MATSUSHITA 2SA838-B
Q109	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q110	30-10-8381	TR SI PNP	MATSUSHITA 2SA838-B
Q111	30-10-8381	TR SI PNP	MATSUSHITA 2SA838-B
Q201	31-20-1073	FET	SONY 2SK107-3
Q202	30-30-9451	TR SI NPN	NEC 2SC945-Q
Q203	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q204	30-30-9451	TR SI NPN	NEC 2SC945-Q
Q205	30-11-2061	TR SI PNP	NEC 2SA1206-L
Q206	30-11-2061	TR SI PNP	NEC 2SA1206-L
Q207	30-10-8381	TR SI PNP	MATSUSHITA 2SA838-B
Q208	30-10-8381	TR SI PNP	MATSUSHITA 2SA838-B
Q210	30-10-8381	TR SI PNP	MATSUSHITA 2SA838-B
Q211	30-10-8381	TR SI PNP	MATSUSHITA 2SA838-B
Q212	30-10-8381	TR SI PNP	MATSUSHITA 2SA838-B
Q213	30-10-8381	TR SI PNP	MATSUSHITA 2SA838-B
Q301	30-11-2061	TR SI PNP	NEC 2SA1206-L
Q302	30-11-2061	TR SI PNP	NEC 2SA1206-L
Q303	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q304	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q305	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q306	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q307	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q308	30-11-2061	TR SI PNP	NEC 2SA1206-L
Q309	30-11-2061	TR SI PNP	NEC 2SA1206-L
Q310	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q311	30-32-5700	TR SI NPN	NEC 2SC2570
Q312	30-20-6481	TR SI PNP	HITACHI 2SB648A
Q313	30-40-6681	TR SI NPN	HITACHI 2SD668A-C

REFERENCE DESIGNATOR		KIKUSUI PARTS NO.	DESCRIPTION	
Q314		30-40-6681	TR SI NPN	HITACHI 2SD668A-C
Q315		30-20-6481	TR SI PNP	HITACHI 2SB648A
Q316		30-32-5700	TR SI NPN	NEC 2SC2570
Q603		30-20-8611	TR SI PNP	HITACHI 2SB861-C
Q604		30-20-8341	TR SI PNP	TOSHIBA 2SB834-Y
Q605		30-40-8802	TR SI NPN	NEC 2SD880--Y
Q606		30-40-8802	TR SI NPN	NEC 2SD880-Y
QCR101		30-31-9071	TR SI NPN	HITACHI 2SC1907
QCR201		30-31-9071	TR SI NPN	HITACHI 2SC1907
U101		34-00-0121	FET OPEAMP	N.S LF13741N
U102		30-90-0141	TRANSISTOR ARRAYS 5 NPN	RCA CA3086
U201		34-00-0121	FET OPEAMP	N.S LF13741N
U202		30-90-0141	TRANSISTOR ARRAYS 5 NPN	RCA CA3086
U301		35-70-0741	DUAL D-FLIP FLOP	T.I SN74LS74N
U302		35-70-0001	QUAD 2-INPUT POSI-NAND	T.I SN74LS00N
U602		34-00-0240	DUAL OPEAMP	NEC UPC4558C
U603		34-00-0240	DUAL OPEAMP	NEC UPC4558C
R102		40-27-0332	FXD C FILM 33 OHM 5% 1/4W	
R103		42-74-5100	FXD M FILM 1M OHM 1% 1/2W	
R104		42-74-4900	FXD M FILM 900K OHM 1% 1/2W	
R105		42-72-4111	FXD M FILM 111K OHM 1% 1/4W	
R106		42-74-4990	FXD M FILM 990K OHM 1% 1/2W	
R107		42-72-3101	FXD M FILM 10.1K OHM 1% 1/4W	
R108		40-27-0222	FXD C FILM 22 OHM 5% 1/4W	
R109		40-27-0682	FXD C FILM 68 OHM 5% 1/4W	
R110		40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R111		40-37-4471	FXD C FILM 470K OHM 5% 1/2W	
R112		40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R113		40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R114		40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R115		40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R116		40-27-1682	FXD C FILM 680 OHM 5% 1/4W	
R117		40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W	
R118		40-27-2822	FXD C FILM 8.2K OHM 5% 1/4W	
R119		40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R120		40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W	
R121		40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R122		40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R123		44-04-0000	FXD M GLAZE R-NETWORK	KIKUSUI S8109001
R124		38-00-0000	THERMISTER 250 OHM	
R131		40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R132		40-27-1122	FXD C FILM 120 OHM 5% 1/4W	
R133		40-27-1122	FXD C FILM 120 OHM 5% 1/4W	
R134		40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R135		40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R136		40-27-1682	FXD C FILM 680 OHM 5% 1/4W	
R137		40-27-3472	FXD C FILM 47K OHM 5% 1/4W	
R138		40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R139		42-72-1470	FXD M FILM 470 OHM 1% 1/4W	
R140		40-27-1272	FXD C FILM 270 OHM 5% 1/4W	
R141		42-72-1470	FXD M FILM 470 OHM 1% 1/4W	
R142		42-72-0560	FXD M FILM 56 OHM 1% 1/4W	
R144		42-72-0560	FXD M FILM 56 OHM 1% 1/4W	
R145		40-27-3472	FXD C FILM 47K OHM 5% 1/4W	
R146		40-27-0272	FXD C FILM 27 OHM 5% 1/4W	
R147		40-27-0272	FXD C FILM 27 OHM 5% 1/4W	
R148		42-72-1680	FXD M FILM 680 OHM 1% 1/4W	
R149		42-72-1680	FXD M FILM 680 OHM 1% 1/4W	
R150		40-27-0222	FXD C FILM 22 OHM 5% 1/4W	
R151		40-27-0222	FXD C FILM 22 OHM 5% 1/4W	
R152		40-27-1152	FXD C FILM 150 OHM 5% 1/4W	
R153		40-27-1152	FXD C FILM 150 OHM 5% 1/4W	
R154		40-27-0222	FXD C FILM 22 OHM 5% 1/4W	
R155		42-72-2100	FXD M FILM 1K OHM 1% 1/4W	
R156		42-72-2100	FXD M FILM 1K OHM 1% 1/4W	
R157		40-27-1222	FXD C FILM 220 OHM 5% 1/4W	
R158	*	40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R159		40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W	
R160		40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R161		40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W	
R162		40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R171		40-27-1122	FXD C FILM 120 OHM 5% 1/4W	
R172		40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W	
R173		40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W	

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION	
R174	40-27-1182	FXD C FILM 180 OHM 5% 1/4W	
R175	40-27-1182	FXD C FILM 180 OHM 5% 1/4W	
R176	40-27-1272	FXD C FILM 270 OHM 5% 1/4W	
R177	40-27-2472	FXD C FILM 4.7K OHM 5% 1/4W	
R178	40-27-2472	FXD C FILM 4.7K OHM 5% 1/4W	
R179	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R180	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R186	40-27-0222	FXD C FILM 22 OHM 5% 1/4W	
R187	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R189	38-00-0000	THERMISTER 250 OHM	
R202	40-27-0332	FXD C FILM 33 OHM 5% 1/4W	
R203	42-74-5100	FXD M FILM 1M OHM 1% 1/2W	
R204	42-74-4900	FXD M FILM 900K OHM 1% 1/2W	
R205	42-72-4111	FXD M FILM 111K OHM 1% 1/4W	
R206	42-74-4990	FXD M FILM 990K OHM 1% 1/2W	
R207	42-72-3101	FXD M FILM 10.1K OHM 1% 1/4W	
R208	40-27-0222	FXD C FILM 22 OHM 5% 1/4W	
R209	40-27-0682	FXD C FILM 68 OHM 5% 1/4W	
R210	40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R211	40-37-4471	FXD C FILM 470K OHM 5% 1/2W	
R212	40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R213	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R214	40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R215	40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R216	40-27-1682	FXD C FILM 680 OHM 5% 1/4W	
R217	40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W	
R218	40-27-2822	FXD C FILM 8.2K OHM 5% 1/4W	
R219	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R220	40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W	
R221	40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R222	40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R223	44-04-0000	FXD M GLAZE R-NETWORK	KIKUSUI S8109001
R231	40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R232	40-27-1122	FXD C FILM 120 OHM 5% 1/4W	
R233	40-27-1122	FXD C FILM 120 OHM 5% 1/4W	
R234	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R235	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R236	40-27-1682	FXD C FILM 680 OHM 5% 1/4W	
R237	40-27-3472	FXD C FILM 47K OHM 5% 1/4W	
R238	40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R239	42-72-1470	FXD M FILM 470 OHM 1% 1/4W	
R240	40-27-1272	FXD C FILM 270 OHM 5% 1/4W	
R241	42-72-1470	FXD M FILM 470 OHM 1% 1/4W	
R242	42-72-0560	FXD M FILM 56 OHM 1% 1/4W	
R244	42-72-0560	FXD M FILM 56 OHM 1% 1/4W	
R245	40-27-3472	FXD C FILM 47K OHM 5% 1/4W	
R246	40-27-0272	FXD C FILM 27 OHM 5% 1/4W	
R247	40-27-0272	FXD C FILM 27 OHM 5% 1/4W	
R248	42-72-1680	FXD M FILM 680 OHM 1% 1/4W	
R249	42-72-1680	FXD M FILM 680 OHM 1% 1/4W	
R250	40-27-0222	FXD C FILM 22 OHM 5% 1/4W	
R251	40-27-0222	FXD C FILM 22 OHM 5% 1/4W	
R252	40-27-1152	FXD C FILM 150 OHM 5% 1/4W	
R253	40-27-1152	FXD C FILM 150 OHM 5% 1/4W	
R254	40-27-0822	FXD C FILM 82 OHM 5% 1/4W	
R255	42-72-2100	FXD M FILM 1K OHM 1% 1/4W	
R256	42-72-2100	FXD M FILM 1K OHM 1% 1/4W	
R257	40-27-1222	FXD C FILM 220 OHM 5% 1/4W	
R258	40-27-1222	FXD C FILM 220 OHM 5% 1/4W	
R271	40-27-1122	FXD C FILM 120 OHM 5% 1/4W	
R272	40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W	
R273	40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W	
R274	40-27-1182	FXD C FILM 180 OHM 5% 1/4W	
R275	40-27-1182	FXD C FILM 180 OHM 5% 1/4W	
R276	40-27-1272	FXD C FILM 270 OHM 5% 1/4W	
R277	40-27-2472	FXD C FILM 4.7K OHM 5% 1/4W	
R278	40-27-2472	FXD C FILM 4.7K OHM 5% 1/4W	
R279	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R282	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R283	40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W	
R284	40-27-2682	FXD C FILM 6.8K OHM 5% 1/4W	
R285	40-27-1222	FXD C FILM 220 OHM 5% 1/4W	
R286	40-27-0222	FXD C FILM 22 OHM 5% 1/4W	
R287	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R301	40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R302	40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R303	42-72-1470	FXD M FILM 470 OHM 1% 1/4W	

REFERENCE DESIGNATOR		KIKUSUI PARTS NO.	DESCRIPTION
R304		42-72-1470	FXD M FILM 470 OHM 1% 1/4W
R305		40-27-1822	FXD C FILM 820 OHM 5% 1/4W
R306		40-27-1822	FXD C FILM 820 OHM 5% 1/4W
R307		40-27-1822	FXD C FILM 820 OHM 5% 1/4W
R308		40-27-0822	FXD C FILM 82 OHM 5% 1/4W
R309		40-27-0822	FXD C FILM 82 OHM 5% 1/4W
R310		40-27-1222	FXD C FILM 220 OHM 5% 1/4W
R311		40-27-1222	FXD C FILM 220 OHM 5% 1/4W
R312		40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R313		40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W
R314		40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R315		40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R316		40-27-3102	FXD C FILM 10K OHM 5% 1/4W
R318		40-27-3102	FXD C FILM 10K OHM 5% 1/4W
R319		40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R320		44-07-0020	FXD M GLAZE RESISTOR NETWORKS 10K OHM X4
R322		40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R331		42-72-0910	FXD M FILM 91 OHM 1% 1/4W
R332		42-72-0910	FXD M FILM 91 OHM 1% 1/4W
R333		42-72-1470	FXD M FILM 470 OHM 1% 1/4W
R334		42-72-1470	FXD M FILM 470 OHM 1% 1/4W
R335		40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R336		40-27-1682	FXD C FILM 680 OHM 5% 1/4W
R337		40-27-1682	FXD C FILM 680 OHM 5% 1/4W
R338		40-27-1472	FXD C FILM 470 OHM 5% 1/4W
R339		40-27-1472	FXD C FILM 470 OHM 5% 1/4W
R340		40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W
R341	*	40-27-3272	FXD C FILM 27K OHM 5% 1/4W
R342		40-27-1222	FXD C FILM 220 OHM 5% 1/4W
R343		40-27-1222	FXD C FILM 220 OHM 5% 1/4W
R344		40-27-0222	FXD C FILM 22 OHM 5% 1/4W
R345		40-27-0222	FXD C FILM 22 OHM 5% 1/4W
R346		44-91-3330	FXD M OXIDE 33K OHM 5% 1W
R347		44-91-3330	FXD M OXIDE 33K OHM 5% 1W
R348		40-27-0102	FXD C FILM 10 OHM 5% 1/4W
R349		40-27-8472	FXD C FILM 4.7 OHM 5% 1/4W
R350		40-27-8472	FXD C FILM 4.7 OHM 5% 1/4W
R351		40-27-2332	FXD C FILM 3.3K OHM 5% 1/4W
R352		40-37-3471	FXD C FILM 47K OHM 5% 1/2W
R353		40-37-3471	FXD C FILM 47K OHM 5% 1/2W
R354		40-27-2332	FXD C FILM 3.3K OHM 5% 1/4W
R355		40-27-8472	FXD C FILM 4.7 OHM 5% 1/4W
R356		40-27-8472	FXD C FILM 4.7 OHM 5% 1/4W
R357		40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R358		40-27-0822	FXD C FILM 82 OHM 5% 1/4W
R359		40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R360		40-27-0102	FXD C FILM 10 OHM 5% 1/4W
R361		40-27-0102	FXD C FILM 10 OHM 5% 1/4W
R362		40-27-1472	FXD C FILM 470 OHM 5% 1/4W
R363		40-27-1472	FXD C FILM 470 OHM 5% 1/4W
R364		40-27-0102	FXD C FILM 10 OHM 5% 1/4W
R365		40-27-0102	FXD C FILM 10 OHM 5% 1/4W
R366		40-27-0102	FXD C FILM 10 OHM 5% 1/4W
R367		40-27-0102	FXD C FILM 10 OHM 5% 1/4W
R368	*	40-27-3102	FXD C FILM 10K OHM 5% 1/4W
R369		40-27-1272	FXD C FILM 270 OHM 5% 1/4W
R370		40-27-8472	FXD C FILM 4.7 OHM 5% 1/4W
R371		40-27-8472	FXD C FILM 4.7 OHM 5% 1/4W
R621		40-37-5221	FXD C FILM 2.2M OHM 5% 1/2W
R622		40-37-5221	FXD C FILM 2.2M OHM 5% 1/2W
R623		44-92-2120	FXD M OXIDE 1.2K OHM 5% 2W
R624		40-27-0102	FXD C FILM 10 OHM 5% 1/4W
R625		40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R626		40-27-1222	FXD C FILM 220 OHM 5% 1/4W
R627		40-27-1562	FXD C FILM 560 OHM 5% 1/4W
R628		42-72-4120	FXD M FILM 120K OHM 1% 1/4W
R629		42-72-2910	FXD M FILM 9.1K OHM 1% 1/4W
R631		44-91-0010	FXD M OXIDE 1 OHM 5% 1W
R632		40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R633		44-91-1100	FXD M OXIDE 100 OHM 5% 1W
R634		40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R635		40-37-8222	FXD C FILM 2.2 OHM 5% 1/2W
R636		44-91-1100	FXD M OXIDE 100 OHM 5% 1W
R637		40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W
R638		42-72-3120	FXD M FILM 12K OHM 1% 1/4W
R639		42-72-3120	FXD M FILM 12K OHM 1% 1/4W
R640		40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W

REFERENCE DESIGNATOR		KIKUSUI PARTS NO.	DESCRIPTION
R641		40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W
R642		42-72-2390	FXD M FILM 3.9K OHM 1% 1/4W
R643		42-72-2910	FXD M FILM 9.1K OHM 1% 1/4W
R644	*	40-27-1152	FXD C FILM 150 OHM 5% 1/4W
R646		40-37-1101	FXD C FILM 100 OHM 5% 1/2W
RV101		48-33-3200	VAR M FILM 20K OHM
RV102		48-33-1100	VAR M FILM 100 OHM
RV103		48-33-1500	VAR M FILM 500 OHM
RV105		48-33-3200	VAR M FILM 20K OHM
RV106		48-33-1100	VAR M FILM 100 OHM
RV107		48-33-2100	VAR M FILM 1K OHM
RV108		48-33-2200	VAR M FILM 2K OHM
RV109		48-33-1500	VAR M FILM 500 OHM
RV110		48-33-2100	VAR M FILM 1K OHM
RV112		48-33-3200	VAR M FILM 20K OHM
RV201		48-33-3200	VAR M FILM 20K OHM
RV202		48-33-1100	VAR M FILM 100 OHM
RV203		48-33-1500	VAR M FILM 500 OHM
RV205		48-33-3200	VAR M FILM 20K OHM
RV207		48-33-2100	VAR M FILM 1K OHM
RV209		48-33-1500	VAR M FILM 500 OHM
RV210		48-33-2100	VAR M FILM 1K OHM
RV212		48-33-3200	VAR M FILM 20K OHM
RV301		48-33-1500	VAR M FILM 500 OHM
RV302		48-33-2200	VAR M FILM 2K OHM
RV606		48-33-2100	VAR M FILM 1K OHM
C101		50-96-3590	FXD PLSTC FILM 0.022UF 20% 630V
C102		57-10-1191	VAR CER 3-10PF
C103		57-10-1181	VAR CER 3-6PF
C104		52-06-3165	FXD CER 33PF 10% 500V TYPE1
C105		57-10-1191	VAR CER 3-10PF
C106		57-10-1181	VAR CER 3-6PF
C107		52-06-2265	FXD CER 220PF 10% 50V TYPE1
C108		52-06-2265	FXD CER 220PF 10% 50V TYPE1
C111		50-87-0510	FXD PLSTC FILM 2200PF 10% 400V
C112		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C113		52-01-3345	FXD CER 1000PF 10% 500V TYPE2
C114		52-01-3345	FXD CER 1000PF 10% 500V TYPE2
C115		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C116		54-00-0311	FXD ELECT 10UF 50V
C117		52-06-3125	FXD CER 15PF 10% 500V TYPE1
C118		52-06-3051	FXD CER 5PF 10% 500V TYPE1
C119		52-06-2225	FXD CER 100PF 10% 50V TYPE1
C121		52-06-2265	FXD CER 220PF 10% 50V TYPE1
C122		52-06-2265	FXD CER 220PF 10% 50V TYPE1
C131		57-10-1203	VAR CER 5-20PF
C132		52-06-3051	FXD CER 5PF 10% 500V TYPE1
C133		52-06-3051	FXD CER 5PF 10% 500V TYPE1
C151		--	--
C152		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C153		54-00-0311	FXD ELECT 10UF 50V
C171		57-10-1223	VAR CER 8-50PF
C172		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C173		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C174		52-06-2225	FXD CER 100PF 10% 50V TYPE1
C175		52-06-2225	FXD CER 100PF 10% 50V TYPE1
C177		52-06-2215	FXD CER 82PF 10% 500V TYPE1
C178		52-06-2215	FXD CER 82PF 10% 500V TYPE1
C179		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C200		52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2
C201		50-96-3590	FXD PLSTC FILM 0.022UF 20% 630V
C202		57-10-1191	VAR CER 3-10PF
C203		57-10-1181	VAR CER 3-6PF
C204		52-06-3165	FXD CER 33PF 10% 500V TYPE1
C205		57-10-1191	VAR CER 3-10PF
C206		57-10-1181	VAR CER 3-6PF
C207		52-06-2265	FXD CER 220PF 10% 50V TYPE1
C208		52-06-2265	FXD CER 220PF 10% 50V TYPE1
C211		50-87-0510	FXD PLSTC FILM 2200PF 10% 400V
C212		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C213		52-01-3345	FXD CER 1000PF 10% 500V TYPE2
C214		52-01-3345	FXD CER 1000PF 10% 500V TYPE2
C215		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C216		54-00-0311	FXD ELECT 10UF 50V
C218		52-06-3051	FXD CER 5PF 10% 500V TYPE1

REFERENCE DESIGNATOR		KIKUSUI PARTS NO.	DESCRIPTION	
C219		52-06-2225	FXD CER 100PF 10% 50V TYPE1	
C221		52-06-2265	FXD CER 220PF 10% 50V TYPE1	
C222		52-06-2265	FXD CER 220PF 10% 50V TYPE1	
C231		57-10-1203	VAR CER 5-20PF	
C232		52-06-3051	FXD CER 5PF 10% 500V TYPE1	
C233		52-06-3051	FXD CER 5PF 10% 500V TYPE1	
C251		-	-	
C252		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2	
C271		57-10-1223	VAR CER 8-50PF	
C272		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2	
C273		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2	
C274		52-06-2225	FXD CER 100PF 10% 50V TYPE1	
C275		52-06-2225	FXD CER 100PF 10% 50V TYPE1	
C277		52-06-2215	FXD CER 82PF 10% 500V TYPE1	
C278		52-06-2215	FXD CER 82PF 10% 500V TYPE1	
C279		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2	
C282		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2	
C301		54-00-0121	FXD ELECT 100UF 25V	
C302		54-00-0121	FXD ELECT 100UF 25V	
C303		52-01-3345	FXD CER 1000PF 10% 500V TYPE2	
C306		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2	
C310		52-01-3365	FXD CER 1500PF 10% 50V TYPE2	
C331		57-10-1203	VAR CER 5-20PF	
C332		52-06-3051	FXD CER 5PF 10% 500V TYPE1	
C333		50-45-0500	FXD PLSTC FILM 0.01MF 5% 50V	
C334		50-45-0500	FXD PLSTC FILM 0.01MF 5% 50V	
C335		52-96-1140	FXD COMP 0.47PF 10% 500V	
C336		52-96-1140	FXD COMP 0.47PF 10% 500V	
C337		50-77-3500	FXD PLSTC FILM 0.047UF 20% 250V	
C338		50-77-3500	FXD PLSTC FILM 0.047UF 20% 250V	
C339		50-96-3590	FXD PLSTC FILM 0.022UF 20% 630V	
C340		-	-	
C341		50-96-3590	FXD PLSTC FILM 0.022UF 20% 630V	
C342		54-60-1550	FXD ELECT 1UF 160V	
C343		52-05-1498	FXD CER 0.1UF +80-20% 25V TYPE2	
C344		50-67-0050	FXD PLSTC FILM 0.047UF 10% 100V	
C345	*	52-06-3155	FXD CER 27PF 10% 500V TYPE1	
C346	*	52-06-3155	FXD CER 27PF 10% 500V TYPE1	
C347		54-00-0311	FXD ELECT 10UF 50V	
C348		54-00-0311	FXD ELECT 10UF 50V	
C349		52-06-3102	FXD CER 10PF 10% 500V TYPE1	
C351		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2	
C352		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2	
C621		50-67-0040	FXD PLSTC FILM 0.022UF 10% 100V	
C622		50-67-0040	FXD PLSTC FILM 0.022UF 10% 100V	
C623		54-60-1620	FXD ELECT 47UF 200V	
C624		54-70-1020	FXD ELECT 2.2UF 250V	
C625		54-60-1550	FXD ELECT 1UF 160V	
C626		54-00-0231	FXD ELECT 1000UF 35V	
C627		54-00-0231	FXD ELECT 1000UF 35V	
C628		54-00-0114	FXD ELECT 47UF 25V	
L301		67-10-0860	INDUCTOR 2.2UH 20%	
L302		67-10-0880	INDUCTOR 2.2UH 20%	
S101		80-98-0580	SW ROTARY WITH RV VOLT/DIV	ALPS S21F2YC
S102		82-70-8231	LEVER SWITCH	ALPS SLR823-1
S201		80-98-0580	SW ROTARY WITH RV VOLT/DIV	ALPS S21F2YC
S202		82-70-8231	LEVER SWITCH	ALPS SLR823-1
S301		82-70-8243	LEVER SWITCH	ALPS SLR824-3
A2 ASSEMBLY				
CR401		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR402		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR403		32-30-0060	DIODE VR=30V IO=30MA	HITACHI 1SS86
CR404		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR452		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR453		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR454		32-92-0033	ZENER VZ=3.2-3.4V	HITACHI HZ3C-2
CR455		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR456		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR457		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR458		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR459		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR460		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR461		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR462		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION	
CR463	32-30-0860	DIODE VR=30V IO=30MA	HITACHI 1SS86
CR464	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR465	32-92-0056	ZENER VZ=5.5-5.8V P=0.4W	NEC RD5.6J
CR468	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR469	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR501	32-30-0860	DIODE VR=30V IO=30MA	HITACHI 1SS86
CR502	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR503	32-30-0830	DIODE VR=250V IO=200MA	HITACHI 1SS83
CR504	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR651	32-92-0056	ZENER VZ=5.5-5.8V P=0.4W	NEC RD5.6J
CR652	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR653	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR654	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR655	32-90-1951	DIODE VR=6KV FAST RECOVERY	SANKEN GHV-06SSN
CR656	32-90-1951	DIODE VR=6KV FAST RECOVERY	SANKEN GHV-06SSN
CR657	32-30-0830	DIODE VR=250V IO=200MA	HITACHI 1SS83
CR658	32-90-1820	DIODE VR=2KV FAST RECOVERY	HITACHI ERB26-20
CR659	32-30-0830	DIODE VR=250V IO=200MA	HITACHI 1SS83
CR660	32-30-0830	DIODE VR=250V IO=200MA	HITACHI 1SS83
CR661	32-30-0830	DIODE VR=250V IO=200MA	HITACHI 1SS83
CR662	32-30-0830	DIODE VR=250V IO=200MA	HITACHI 1SS83
CR663	32-30-0830	DIODE VR=250V IO=200MA	HITACHI 1SS83
CR664	32-30-0830	DIODE VR=250V IO=200MA	HITACHI 1SS83
CR665	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR666	32-92-0022	ZENER VZ=2.1-2.3V	HITACHI HZ2B-3
CR667	32-92-0022	ZENER VZ=2.1-2.3V	HITACHI HZ2B-3
CR668	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR669	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR701	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR702	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR703	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR704	32-30-0860	DIODE VR=30V IO=30MA	HITACHI 1SS86
CR705	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR706	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR707	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR708	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR709	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
Q401	30-10-8381	TR SI PNP	MATSUSHITA 2SA838-B
Q402	30-10-8381	TR SI PNP	MATSUSHITA 2SA838-B
Q403	31-20-1073	FET	SONY 2SK107-3
Q404	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q405	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q406	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q407	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q408	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q409	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q410	31-20-1171	FET	TOSHIBA 2SK117-BL
Q411	30-11-0151	TR SI PNP	TOSHIBA 2SA1015-Y
Q412	30-10-8381	TR SI PNP	MATSUSHITA 2SA838-B
Q413	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q415	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q416	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q417	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q418	30-30-9451	TR SI NPN	NEC 2SC945-Q
Q419	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q420	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q421	30-30-9451	TR SI NPN	NEC 2SC945-Q
Q422	30-30-9451	TR SI NPN	NEC 2SC945-Q
Q423	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q424	30-31-8431	TR SI NPN	NEC 2SC1843-E
Q425	31-20-1171	FET	TOSHIBA 2SK117-BL
Q426	31-20-1171	FET	TOSHIBA 2SK117-BL
Q427	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q428	30-30-9451	TR SI NPN	NEC 2SC945-Q
Q429	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q430	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q431	30-30-9451	TR SI NPN	NEC 2SC945-Q
Q501	30-11-0151	TR SI PNP	TOSHIBA 2SA1015-Y
Q502	30-11-0151	TR SI PNP	TOSHIBA 2SA1015-Y
Q503	30-30-9451	TR SI NPN	NEC 2SC945-Q
Q504	30-30-9451	TR SI NPN	NEC 2SC945-Q
Q505	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q506	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q507	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q508	30-10-8381	TR SI PNP	MATSUSHITA 2SA838-B
Q509	30-20-6481	TR SI PNP	HITACHI 2SB648A

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION	
Q510	30-40-6681	TR SI NPN	HITACHI 2SD668A-C
Q511	30-40-6681	TR SI NPN	HITACHI 2SD668A-C
Q512	30-20-6481	TR SI PNP	HITACHI 2SB648A
Q651	30-40-8802	TR SI NPN	NEC 2SD880-Y
Q652	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q654	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q655	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q656	30-32-3710	TR SI NPN	NEC 2SC2371-L
Q657	30-32-3710	TR SI NPN	NEC 2SC2371-L
Q658	30-32-3710	TR SI NPN	NEC 2SC2371-L
Q659	30-32-3710	TR SI NPN	NEC 2SC2371-L
Q660	31-20-1171	FET	TOSHIBA 2SK117-BL
Q702	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q703	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q704	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q705	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q706	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q707	30-30-9451	TR SI NPN	NEC 2SC945-Q
Q708	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q709	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q710	31-20-1171	FET	TOSHIBA 2SK117-BL
Q711	30-31-8431	TR SI NPN	NEC 2SC1843-E
Q712	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q713	30-10-8441	TR SI PNP	HITACHI 2SA844-D
U401	35-70-0001	QUAD 2-INPUT POSI-NAND	T.I SN74LS00N
U402	35-70-1121	DUAL J-K F-F	T.I SN74LS112N
U403	34-00-0215	J-FET INPUT OPEAMP	N.S LF13741N
U404	34-69-0030	TRIPLE 2-CHANNEL MULTIPLEXER	TOSHIBA TC4053BP
U651	34-00-0215	J-FET INPUT OPEAMP	N.S LF13741N
U701	35-70-1121	DUAL J-K F-F	T.I SN74LS112N
U702	35-70-0001	QUAD 2-INPUT POSI-NAND	T.I SN74LS00N
U703	34-00-0215	J-FET INPUT OPEAMP	N.S LF13741N
R401	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R402	42-72-2100	FXD M FILM 1K OHM 1% 1/4W	
R403	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R404	40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W	
R405	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R406	40-27-2332	FXD C FILM 3.3K OHM 5% 1/4W	
R407	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R408	40-27-3472	FXD C FILM 47K OHM 5% 1/4W	
R409	42-74-5100	FXD M FILM 1M OHM 1% 1/2W	
R410	40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R411	40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W	
R412	40-27-1562	FXD C FILM 560 OHM 5% 1/4W	
R413	40-27-1562	FXD C FILM 560 OHM 5% 1/4W	
R414	40-27-0682	FXD C FILM 68 OHM 5% 1/4W	
R415	40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W	
R416	40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W	
R417	40-27-1682	FXD C FILM 680 OHM 5% 1/4W	
R418	40-27-1682	FXD C FILM 680 OHM 5% 1/4W	
R419	40-27-1682	FXD C FILM 680 OHM 5% 1/4W	
R420	40-27-1682	FXD C FILM 680 OHM 5% 1/4W	
R421	40-27-4102	FXD C FILM 100K OHM 5% 1/4W	
R422	40-27-4102	FXD C FILM 100K OHM 5% 1/4W	
R423	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R424	40-27-3222	FXD C FILM 22K OHM 5% 1/4W	
R425	40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R427	40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R428	40-27-0332	FXD C FILM 33 OHM 5% 1/4W	
R429	40-27-1562	FXD C FILM 560 OHM 5% 1/4W	
R431	40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R432	40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R433	40-27-4472	FXD C FILM 470K OHM 5% 1/4W	
R434	40-27-4472	FXD C FILM 470K OHM 5% 1/4W	
R435	40-27-1392	FXD C FILM 390 OHM 5% 1/4W	
R436	40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R437	40-27-1272	FXD C FILM 270 OHM 5% 1/4W	
R438	40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R440	40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R441	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R442	40-27-8472	FXD C FILM 4.7 OHM 5% 1/4W	
R443	40-27-3472	FXD C FILM 47K OHM 5% 1/4W	
R451	— —		
R452	40-27-1332	FXD C FILM 330 OHM 5% 1/4W	
R453	40-27-0222	FXD C FILM 22 OHM 5% 1/4W	

REFERENCE DESIGNATOR		KIKUSUI PARTS NO.	DESCRIPTION	
R454		40-27-3472	FXD C FILM 47K OHM 5% 1/4W	
R455		40-27-2182	FXD C FILM 1.8K OHM 5% 1/4W	
R456		40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R458		40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R459		40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R460		40-27-3472	FXD C FILM 47K OHM 5% 1/4W	
R461		42-72-3220	FXD M FILM 22K OHM 1% 1/4W	
R462		42-72-3330	FXD M FILM 33K OHM 1% 1/4W	
R463		40-27-2272	FXD C FILM 2.7K OHM 5% 1/4W	
R466		40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R467		40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R468		40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R469		40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R470		40-27-1822	FXD C FILM 820 OHM 5% 1/4W	
R471		40-27-3562	FXD C FILM 56K OHM 5% 1/4W	
R472		40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R473		40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W	
R474	*	- -		
R475		40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W	
R476		40-27-3182	FXD C FILM 18K OHM 5% 1/4W	
R477		40-27-1222	FXD C FILM 220 OHM 5% 1/4W	
R478		42-72-2220	FXD M FILM 2.2K OHM 1% 1/4W	
R479		40-27-4472	FXD C FILM 470K OHM 5% 1/4W	
R480		40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R481		40-27-3332	FXD C FILM 33K OHM 5% 1/4W	
R482		40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R483		40-27-2472	FXD C FILM 4.7K OHM 5% 1/4W	
R484		42-72-2160	FXD M FILM 1.6K OHM 1% 1/4W	
R485		40-27-4102	FXD C FILM 100K OHM 5% 1/4W	
R486		40-27-2332	FXD C FILM 3.3K OHM 5% 1/4W	
R487		40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R488		40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R489		40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R491		42-24-0231	FXD M GLAZE 5M OHM 1% 0.31W	
R492		42-74-5100	FXD M FILM 1M OHM 1% 1/2W	
R493		44-04-0010	FXD M GLAZE R-NETWORK	KIKUSUI S8109011
R494		42-72-2390	FXD M FILM 3.9K OHM 1% 1/4W	
R495		42-72-1470	FXD M FILM 470 OHM 1% 1/4W	
R496		40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R498		40-27-1562	FXD C FILM 560 OHM 5% 1/4W	
R499		40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R501		40-27-2682	FXD C FILM 6.8K OHM 5% 1/4W	
R502		40-27-1472	FXD C FILM 470 OHM 5% 1/4W	
R503		42-72-0560	FXD M FILM 56 OHM 1% 1/4W	
R504		40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R505		40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R506		40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R507		40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R508		42-72-2100	FXD M FILM 1K OHM 1% 1/4W	
R509		42-72-2100	FXD M FILM 1K OHM 1% 1/4W	
R510		42-72-2100	FXD M FILM 1K OHM 1% 1/4W	
R511		42-72-2120	FXD M FILM 1.2K OHM 1% 1/4W	
R512		40-27-1332	FXD C FILM 330 OHM 5% 1/4W	
R513		40-27-1332	FXD C FILM 330 OHM 5% 1/4W	
R514		40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R515		40-27-4102	FXD C FILM 100K OHM 5% 1/4W	
R516		40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R517		40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R518		42-72-4100	FXD M FILM 100K OHM 1% 1/4W	
R519		42-72-4100	FXD M FILM 100K OHM 1% 1/4W	
R520		40-27-4102	FXD C FILM 100K OHM 5% 1/4W	
R521		40-27-4102	FXD C FILM 100K OHM 5% 1/4W	
R522		40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W	
R523		40-27-1332	FXD C FILM 330 OHM 5% 1/4W	
R524		40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W	
R525		40-27-1332	FXD C FILM 330 OHM 5% 1/4W	
R526		40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R527		40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R528	*	- -		
R651		42-72-2820	FXD M FILM 8.2K OHM 1% 1/4W	
R652		42-72-3120	FXD M FILM 12K OHM 1% 1/4W	
R653	*	- -		
R654		42-72-3680	FXD M FILM 68K OHM 1% 1/4W	
R655		40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R656		40-27-0000	JUMPER PARTS	
R657		44-91-0010	FXD M OXIDE 1 OHM 5% 1W	
R658		40-27-2472	FXD C FILM 4.7K OHM 5% 1/4W	

REFERENCE DESIGNATOR		KIKUSUI PARTS NO.	DESCRIPTION	
R659		40-27-1472	FXD C FILM 470 OHM 5% 1/4W	
R660		40-37-3221	FXD C FILM 22K OHM 5% 1/2W	
R661		40-37-5221	FXD C FILM 2.2M OHM 5% 1/2W	
R662		42-44-0300	FXD M GLAZE 10M OHM 1% 2.5W	
R663		40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R664		40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R665		40-37-5221	FXD C FILM 2.2M OHM 5% 1/2W	
R666		40-37-6101	FXD C FILM 10M OHM 5% 1/2W	
R667		40-37-6101	FXD C FILM 10M OHM 5% 1/2W	
R668		40-27-2332	FXD C FILM 3.3K OHM 5% 1/4W	
R669		40-37-5151	FXD C FILM 1.5M OHM 5% 1/2W	
R670		40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R671		40-27-4102	FXD C FILM 100K OHM 5% 1/4W	
R673		40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R674		40-37-6101	FXD C FILM 10M OHM 5% 1/2W	
R675		40-37-6101	FXD C FILM 10M OHM 5% 1/2W	
R676		40-37-5151	FXD C FILM 1.5M OHM 5% 1/2W	
R677		40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R678		40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R679		40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R680		40-27-4472	FXD C FILM 470K OHM 5% 1/4W	
R681		40-27-2182	FXD C FILM 1.8K OHM 5% 1/4W	
R683		40-27-2332	FXD C FILM 3.3K OHM 5% 1/4W	
R684		40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R685		40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R686		40-27-1222	FXD C FILM 220 OHM 5% 1/4W	
R687		40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R688		40-27-1332	FXD C FILM 330 OHM 5% 1/4W	
R689		40-27-2472	FXD C FILM 4.7K OHM 5% 1/4W	
R690		40-37-3471	FXD C FILM 47K OHM 5% 1/2W	
R691		40-37-3471	FXD C FILM 47K OHM 5% 1/2W	
R692		40-37-3471	FXD C FILM 47K OHM 5% 1/2W	
R693		40-27-1682	FXD C FILM 680 OHM 5% 1/4W	
R694		40-27-1682	FXD C FILM 680 OHM 5% 1/4W	
R695		40-37-3471	FXD C FILM 47K OHM 5% 1/2W	
R696		40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R697		40-27-4102	FXD C FILM 100K OHM 5% 1/4W	
R698	*	40-27-3392	FXD C FILM 39K OHM 5% 1/4W	
R699		40-27-3562	FXD C FILM 56K OHM 5% 1/4W	
R702		40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R703		40-27-1472	FXD C FILM 470 OHM 5% 1/4W	
R704		40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W	
R705		40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R706		40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W	
R707		40-27-3182	FXD C FILM 18K OHM 5% 1/4W	
R708		40-27-3222	FXD C FILM 22K OHM 5% 1/4W	
R709		40-27-3562	FXD C FILM 56K OHM 5% 1/4W	
R710		40-27-3473	FXD C FILM 47K OHM 5% 1/4W	
R711		40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R712		40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R713		40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R714		42-72-3330	FXD M FILM 33K OHM 1% 1/4W	
R715		42-72-3220	FXD M FILM 22K OHM 1% 1/4W	
R716		40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W	
R717		40-27-3182	FXD C FILM 18K OHM 5% 1/4W	
R718		40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W	
R719		40-27-1222	FXD C FILM 220 OHM 5% 1/4W	
R720		42-72-2150	FXD M FILM 1.5K OHM 1% 1/4W	
R721		42-72-2220	FXD M FILM 2.2K OHM 1% 1/4W	
R722		40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R723		40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R724		44-25-0000	FXD M GLAZE R-NETWORK	KIKUSUI S8109021
R725		40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R730		40-27-2182	FXD C FILM 1.8K OHM 5% 1/4W	
R1401		40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R1403		40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R1404		40-27-4472	FXD C FILM 470K OHM 5% 1/4W	
R1405		40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R1652		40-27-3152	FXD C FILM 15K OHM 5% 1/4W	
R1654		40-27-2332	FXD C FILM 3.3K OHM 5% 1/4W	
RV401		48-33-2500	VAR M FILM 5K OHM	
RV404		48-33-4500	VAR M FILM 500K OHM	
RV405		48-33-3100	VAR M FILM 10K OHM	
RV651		48-26-5220	VAR M GLAZE 2.2M OHM	
RV652		48-33-4100	VAR M FILM 100K OHM	
RV653		48-33-3200	VAR M FILM 20K OHM	

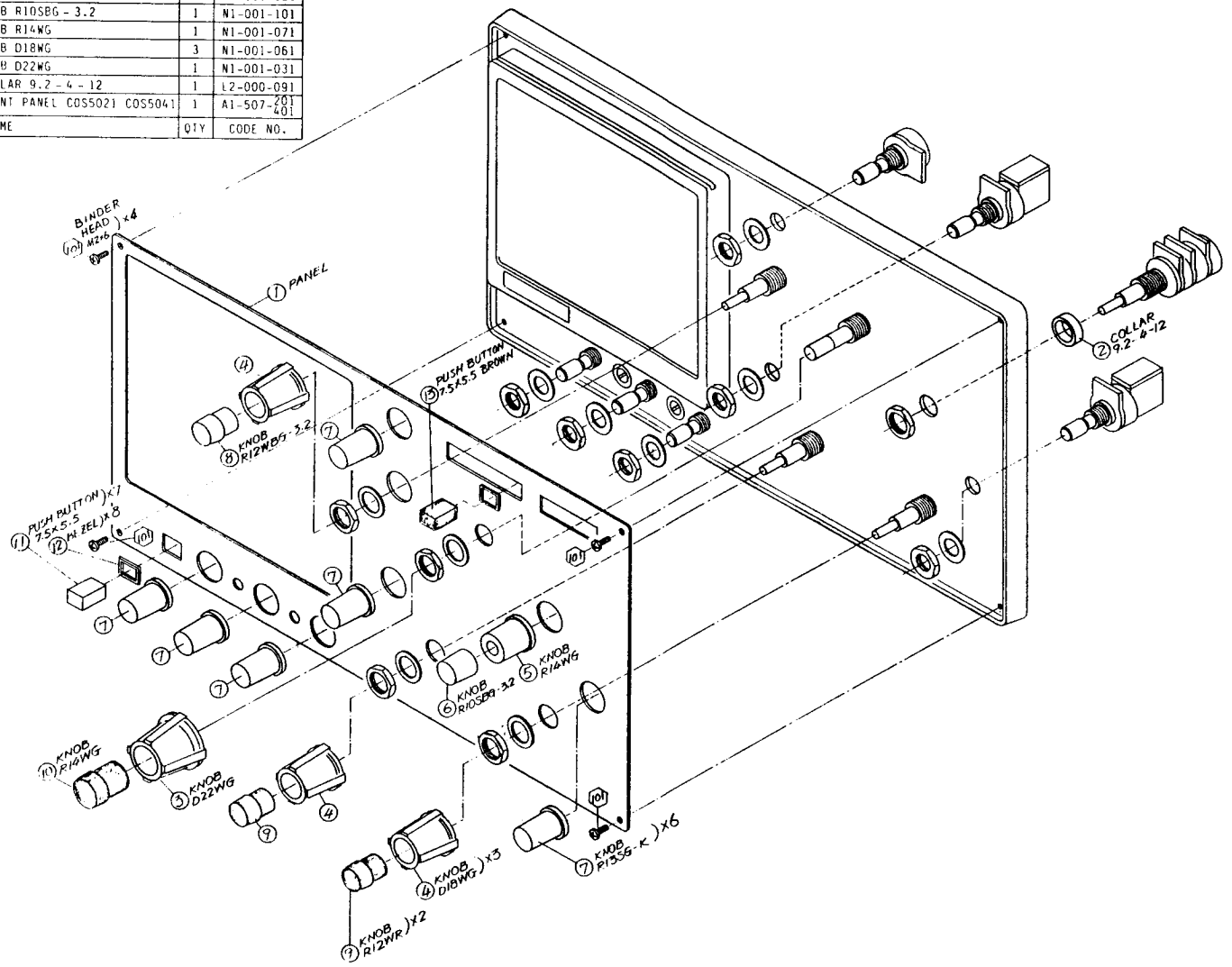
REFERENCE DESIGNATOR		KIKUSUI PARTS NO.	DESCRIPTION
RV702		48-33-2100	VAR M FILM 1K OHM
RV703		48-33-2200	VAR M FILM 2K OHM
C401		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C402		50-67-0040	FXD PLSTC FILM 0.022UF 10% 100V
C403		52-06-3185	FXD CER 47PF 10% 500V TYPE1
C404		52-06-3185	FXD CER 47PF 10% 500V TYPE1
C405	*	52-06-3185	FXD CER 47PF 10% 500V TYPE1
C406		54-00-0114	FXD ELECT 47UF 25V
C407		54-00-0114	FXD ELECT 47UF 25V
C408		54-00-0311	FXD ELECT 10UF 50V
C409		54-00-0311	FXD ELECT 10UF 50V
C410		54-00-0311	FXD ELECT 10UF 50V
C411	*	-	-
C431		55-37-2050	FXD TANT ELECT 1UF 35V
C432		54-00-0311	FXD ELECT 10UF 50V
C433		50-67-0030	FXD PLSTC FILM 0.01UF 10% 100V
C451		52-06-3185	FXD CER 47PF 10% 500V TYPE1
C452		54-00-0114	FXD ELECT 47UF 25V
C454		52-01-3345	FXD CER 1000PF 10% 500V TYPE2
C455		52-06-3185	FXD CER 47PF 10% 500V TYPE1
C456		54-00-0311	FXD ELECT 10UF 50V
C457		54-00-0114	FXD ELECT 47UF 25V
C458		52-06-2225	FXD CER 100PF 10% 50V TYPE1
C459		50-65-0530	FXD M PLSTC FILM 1000PF 5% 100V
C460		50-65-0540	FXD M PLSTC FILM 1UF 5% 100V
C461		54-00-0114	FXD ELECT 47UF 25V
C462		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C463		54-00-0311	FXD ELECT 10UF 50V
C464		54-00-0311	FXD ELECT 10UF 50V
C465		52-06-3125	FXD CER 15PF 10% 500V TYPE1
C467		52-01-3345	FXD CER 1000PF 10% 500V TYPE2
C468		50-67-0030	FXD PLSTC FILM 0.01UF 10% 100V
C469		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C503		52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2
C504		52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2
C506		52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2
C507		52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2
C508		54-00-0311	FXD ELECT 10UF 50V
C509		52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2
C510		54-00-0311	FXD ELECT 10UF 50V
C511	*	-	-
C651		54-00-0311	FXD ELECT 10UF 50V
C652		54-00-0311	FXD ELECT 10UF 50V
C653		52-01-3365	FXD CER 1500PF 10% 50V TYPE2
C654		50-67-0040	FXD PLSTC FILM 0.022UF 10% 100V
C655		54-00-0312	FXD ELECT 22UF 50V
C656		55-37-2050	FXD TANT ELECT 1UF 35V
C657		52-98-1000	FXD CER 4700PF +80-20% 3.15KV TYPE1
C658		52-98-1000	FXD CER 4700PF +80-20% 3.15KV TYPE1
C659		52-98-1000	FXD CER 4700PF +80-20% 3.15KV TYPE1
C660		52-98-1010	FXD CER 1000PF +80-20% 6.3KV TYPE1
C661		52-98-1010	FXD CER 1000PF +80-20% 6.3KV TYPE1
C662		52-98-1010	FXD CER 1000PF +80-20% 6.3KV TYPE1
C663		52-98-1010	FXD CER 1000PF +80-20% 6.3KV TYPE1
C664		52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2
C665		52-98-1010	FXD CER 1000PF +80-20% 6.3KV TYPE1
C666		52-98-1010	FXD CER 1000PF +80-20% 6.3KV TYPE1
C667		52-98-1000	FXD CER 4700PF +80-20% 3.15KV TYPE1
C668		52-08-5145	FXD CER 22PF 10% 2KV TYPE1
C669		50-67-0040	FXD PLSTC FILM 0.022UF 10% 100V
C681		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C682		52-06-2265	FXD CER 220PF 10% 50V TYPE1
C683		54-00-0311	FXD ELECT 10UF 50V
C684		54-00-0311	FXD ELECT 10UF 50V
C685		52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2
C686		54-00-0311	FXD ELECT 10UF 50V
C687		52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2
C688		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C689		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C701		52-06-3185	FXD CER 47PF 10% 500V TYPE1
C702		50-65-0530	FXD M PLSTC FILM 1000PF 5% 100V
C703		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C704		54-00-0311	FXD ELECT 10UF 50V
C705		54-00-0311	FXD ELECT 10UF 50V
C707		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
DS651		23-70-0000	LAMP NEON

REFERENCE DESIGNATOR		KIKUSUI PARTS NO.	DESCRIPTION	
DS652		23-70-0000	LAMP NEON	
L650		67-10-0890	INDUCTOR 100UH 10%	
S401		82-70-5242	LEVER SWITCH	ALPS SLR524-2
S402		82-70-5242	LEVER SWITCH	ALPS SLR524-2
S403		82-70-5222	PUSH SWITCH	ALPS SLR522-2
S406		80-98-0610	SW ROTALY WITH RV A SWEEP/DIV	ALPS S21P 2421/RV
S701		80-98-0620	SW ROTALY B SWEEP/DIV	ALPS S21P 1111/RV
T651		63-92-0130	CONVERTOR TRANS	KIKUSUI S810115
A4 ASSEMBLY				
CR1601		32-92-0360	ZENER VZ=35.3-36.8V	HITACHI HZ36L-2
CR1602		32-92-0360	ZENER VZ=35.3-36.8V	HITACHI HZ36L-2
CR1603		32-92-0360	ZENER VZ=35.3-36.8V	HITACHI HZ36L-2
CR1604		32-92-0360	ZENER VZ=35.3-36.8V	HITACHI HZ36L-2
CR1605		37-00-0060	LAMP LED GREEN	TOSHIBA TLG-105
Q1601		30-31-8461	TR SI NPN	MATSUSHITA 2SC1846-R
Q1602		30-31-8461	TR SI NPN	MATSUSHITA 2SC1846-R
U1601		35-60-0000	QUAD 2-INPUT NAND GATES	TOSHIBA TC4011BP
R1601	*	40-27-4102	FXD C FILM 100K OHM 5% 1/4W	
R1602		40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R1603		40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R1604		40-27-4102	FXD C FILM 100K OHM 5% 1/4W	
R1605		40-27-4102	FXD C FILM 100K OHM 5% 1/4W	
R1606		40-27-4222	FXD C FILM 220K OHM 5% 1/4W	
R1607		40-27-4472	FXD C FILM 470K OHM 5% 1/4W	
R1608		40-27-4472	FXD C FILM 470K OHM 5% 1/4W	
R1609		40-27-1472	FXD C FILM 470 OHM 5% 1/4W	
R1610		42-72-3100	FXD M FILM 10K OHM 1% 1/4W	
R1611	*	40-27-4102	FXD C FILM 100K OHM 5% 1/4W	
R1612		42-72-2200	FXD M FILM 2K OHM 1% 1/4W	
R1613		40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R1614		40-27-1682	FXD C FILM 680 OHM 5% 1/4W	
R1615		40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R1616		40-27-1562	FXD C FILM 560 OHM 5% 1/4W	
RV706		45-43-3100	VAR M GLAZE 10K OHM	
RV1601		45-44-3100	VAR C COMP 10K OHM	
RV1603		45-44-4200	VAR C COMP 200K OHM	
RV1604		45-43-2200	VAR M GLAZE 2K OHM	
RV1605		45-44-3100	VAR C COMP 10K OHM	
C1605		50-45-0500	FXD PLSTC FILM 0.01MF 5% 50V	
C1606		50-45-0500	FXD PLSTC FILM 0.01MF 5% 50V	
C1607		52-06-3051	FXD CER 5PF 10% 500V TYPE1	
C1608		52-01-3345	FXD CER 1000PF 10% 500V TYPE2	
C1609		54-00-0114	FXD ELECT 47UF 25V	
C1610		52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2	
DS1601		23-44-0000	LAMP 14V 80MA	
DS1602		23-44-0000	LAMP 14V 80MA	
B ASSEMBLY				
CR409		37-00-0082	LAMP LED RED	TOSHIBA TLR102KW
CR451		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
R101		40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R201		40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R426		40-27-2822	FXD C FILM 8.2K OHM 5% 1/4W	
R457		40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R731		44-07-0020	FXD M GLAZE RESISTOR NETWORKS 10K OHM X4	
R1402		40-27-0562	FXD C FILM 56 OHM 5% 1/4W	
RV111		45-01-0700	VAR C COMP 10K OHM WITH SW	
RV211		45-01-0700	VAR C COMP 10K OHM WITH SW	
RV402		45-01-0550	VAR C COMP 10K/100K OHM B	
RV501		45-35-3103	VAR C COMP 10K OHM	
C453		52-01-3345	FXD CER 1000PF 10% 500V TYPE2	
C466		52-05-1498	FXD CER 0.1UF +80-20% 25V TYPE2	
C601		52-77-1000	FXD CER 100PF 250VAC	
C602		52-77-1000	FXD CER 100PF 250VAC	

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION	
S404	81-03-0270	PUSH SWITCH	ALPS SUE30
S702	81-04-0260	PUSH SWITCH	ALPS SUE40
S1601	81-01-0270	PUSH SWITCH	ALPS SDG5P-E
T601	60-44-0110	POWER TRANS	KIKUSUI S820041
V601	21-16-0601	CRT	TOSHIBA 150BTB31

14			
13	PUSH BUTTON 7.5× 5.5 BRN	1	P2-000-371
12	BEZEL FOR PUSH BUTTON	8	P2-000-331
11	PUSH BUTTON 7.5 ×5.5	7	P2-000-321
10	KNOB R14WR	1	N2-000-061
9	KNOB R12WR - 2.5	2	N2-000-051
8	KNOB R12WBG - 2.5	1	N1-001-131
7	KNOB R13SG - K	6	N1-001-121
6	KNOB R10SBG - 3.2	1	N1-001-101
5	KNOB R14WG	1	N1-001-071
4	KNOB D18WG	3	N1-001-061
3	KNOB D22WG	1	N1-001-031
2	COLLAR 9.2 - 4 - 12	1	L2-000-091
1	FRONT PANEL COS5021 COS5041	1	A1-507-201/401
NO.	NAME	QTY	CODE NO.

105			
104			
103			
102			
101	BINDER HEAD SCREW M2x6 B-NI	4	M2-000-021
NO.	NAME	QTY	CODE NO.



For Service Manuals Contact
MAURITRON TECHNICAL SERVICES
8 Cherry Tree Rd, Chinnor
Oxon OX9 4QY
Tel:- 01844-351694 Fax:- 01844-352554
Email:- enquiries@mauritron.co.uk

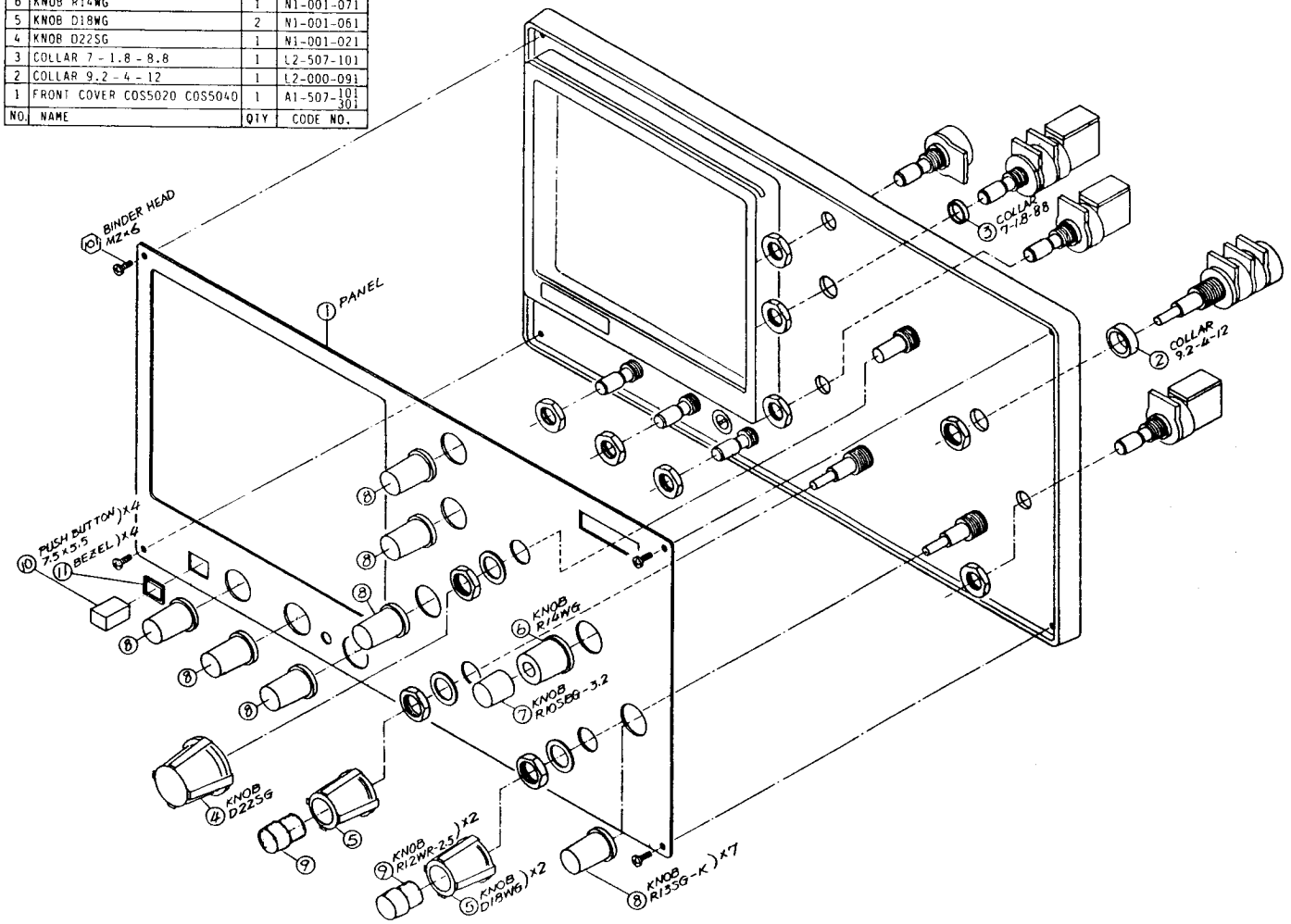
FRONT PANEL ASSEMBLY

(COS5021, COS5041)

316097

NO.	NAME	QTY	CODE NO.
14			
13			
12			
11	BEZEL FOR PUSH BUTTON	4	P2-000-331
10	PUSH BUTTON 7.5×5.5	4	P2-000-321
9	KNOB R12WR-2.5	2	N2-000-051
8	KNOB R13SG-K	7	N1-001-121
7	KNOB R10SBG-3.2	1	N1-001-101
6	KNOB R14WG	1	N1-001-071
5	KNOB D18WG	2	N1-001-061
4	KNOB D22SG	1	N1-001-021
3	COLLAR 7-1.8-8.8	1	L2-507-101
2	COLLAR 9.2-4-12	1	L2-000-091
1	FRONT COVER COS5020 COS5040	1	A1-507-101/301

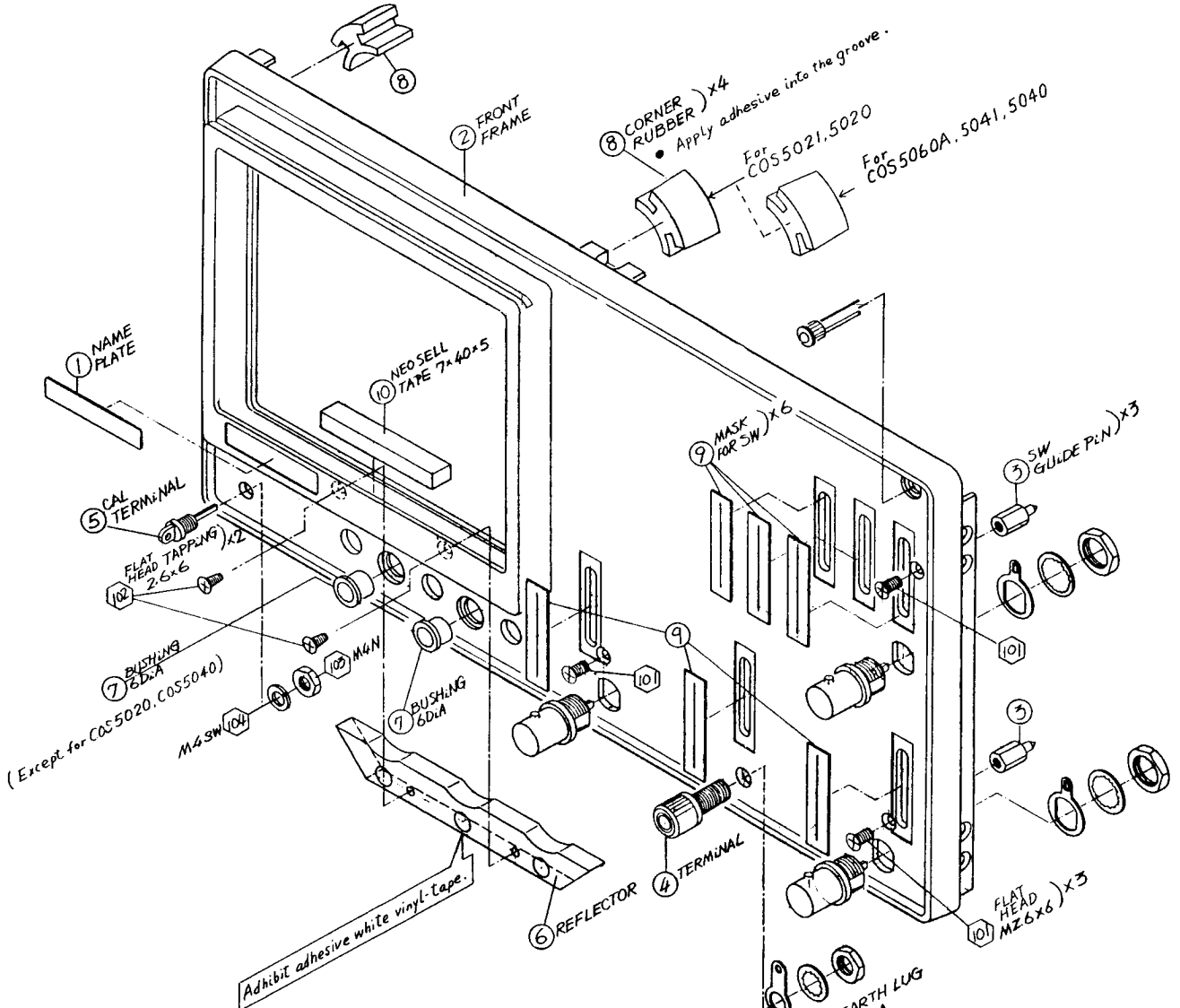
NO.	NAME	QTY	CODE NO.
105			
104			
103			
102			
101	BINDER HEAD SCREW M2×6 B-NI	4	M2-000-021



FRONT PANEL ASSEMBLY

(COS5020, COS5040)

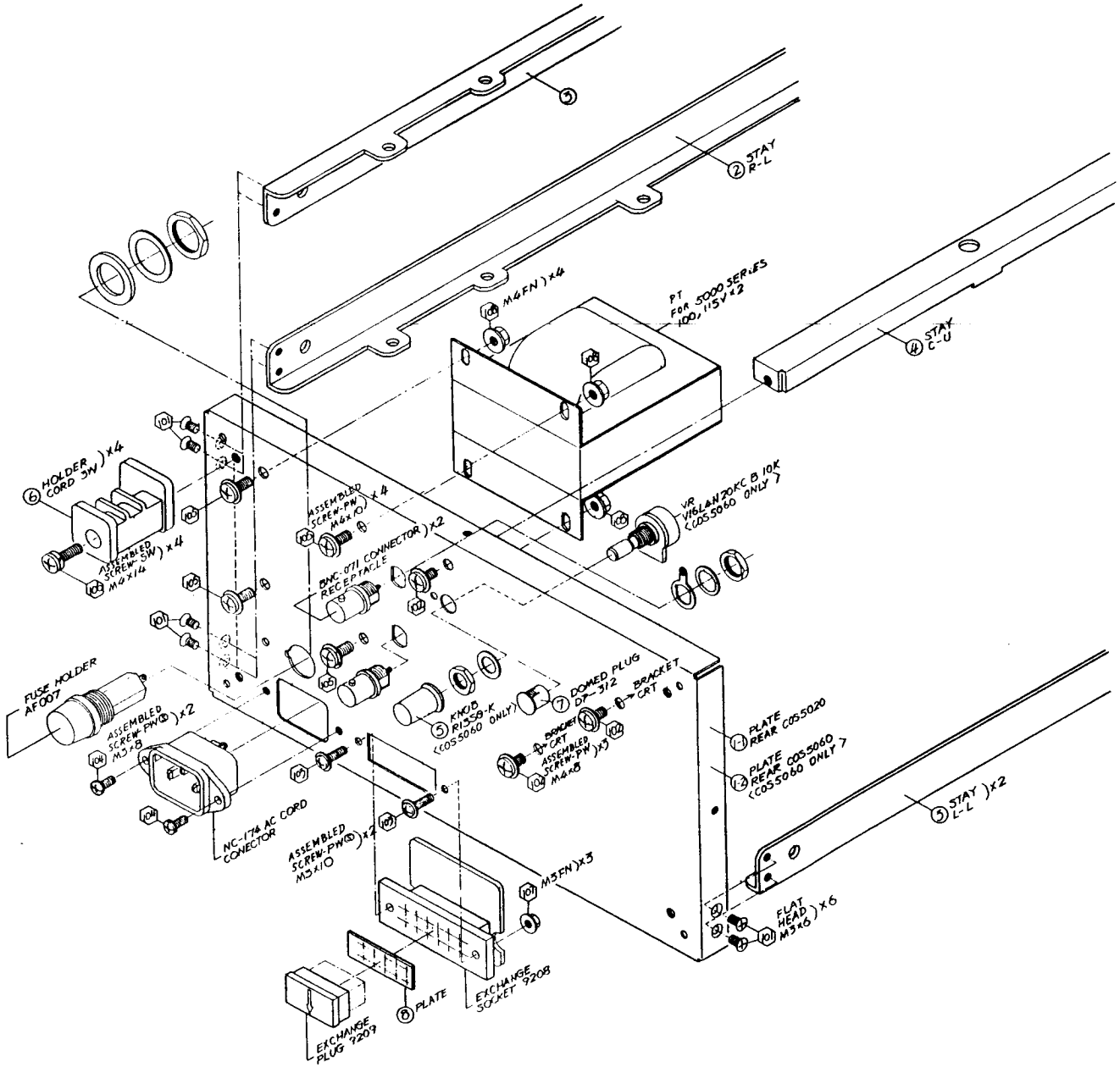
316098



15			
14			
13			
12			
11			
10	RUBBER TAPE 7×40×5	1	R3-050-041
9	MASK FOR SW	6	Q9-507-101
8	CORNER RUBBER FOR CRT	4	P5-507-101
7	SNAP BUSHING 6DIA	1+(1)	P4-000-771
6	REFLECTOR	1	P3-507-101
5	CAL TERMINAL	1	P2-000-291
4	TERMINAL GND SHORT	1	L4-000-021
3	SW GUIDE PIN	3	L3-506-702
2	FRONT FRAME	1	B9-050-151
1	NAME PLATE KIKUSUI	1	A8-000-621
NO.	NAME	QTY	CODE NO.

105	EARTH LUG 6DIA	1	M6-000-151
104	SPRING WASHER M4SW	1	M5-011-041
103	NUT M4N	1	M4-011-041
102	FLAT HEAD SCREW TAPPING 2.6×6	2	M2-001-401
101	FLAT HEAD SCREW M2.6×6	3	M2-001-041
NO.	NAME	QTY	CODE NO.

FRONT FRAME ASSEMBLY
(COMMON DRAWING)



110			
109	ASSEMBLED SCREW-PW M3x6 B-NI	1	M3-000-011
108	FLANGE NUT M4FN	4	M4-010-031
107	FLANGE NUT M3FN	3	M4-010-021
106	ASSEMBLED SCREW-SW M4 × 14	4	M3-011-101
105	ASSEMBLED SCREW-PW M4×10 B-NI	4	M3-000-061
104	ASSEMBLED SCREW-PW(S) M3×8 B-NI	2	M3-000-041
103	ASSEMBLED SCREW-PW(S) M3×10 B-NI	2	M3-000-051
102	ASSEMBLED SCREW-PW M4×8 B-NI	3	M3-000-021
101	FLAT HEAD SCREW M3 × 6	6	M2-001-081
NO.	NAME	QTY	CODE NO.

COS5020,5021,5040,5041

7	DOMED PLUG DP-312	1	P4-050-081
1-1	REAR PLATE COS5020	1	B6-507-101
NO.	NAME	QTY	CODE NO.

FOR COS5060/COS5060A ONLY

5	ROUND KNOB R13SG-K	1	N1-001-121
1-2	REAR PLATE COS5060	1	B6-507-501
NO.	NAME	QTY	CODE NO.

8	PLATE VOLTAGE SELECTOR	1	Q2-000-191
6	HOLDER CORD 3W	4	P3-000-101
4	STAY C-U	1	D5-507-103
3	STAY L-L	2	D5-507-102
2	STAY R-L	1	D5-507-101
NO.	NAME	QTY	CODE NO.

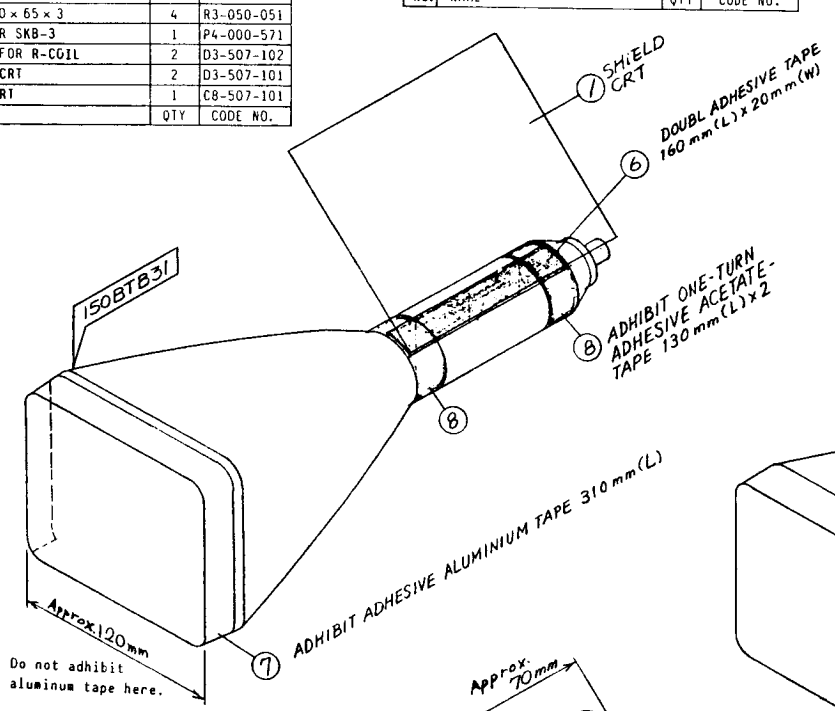
REAR PLATE ASSEMBLY

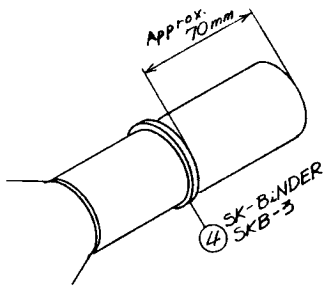
(COMMON DRAWING)

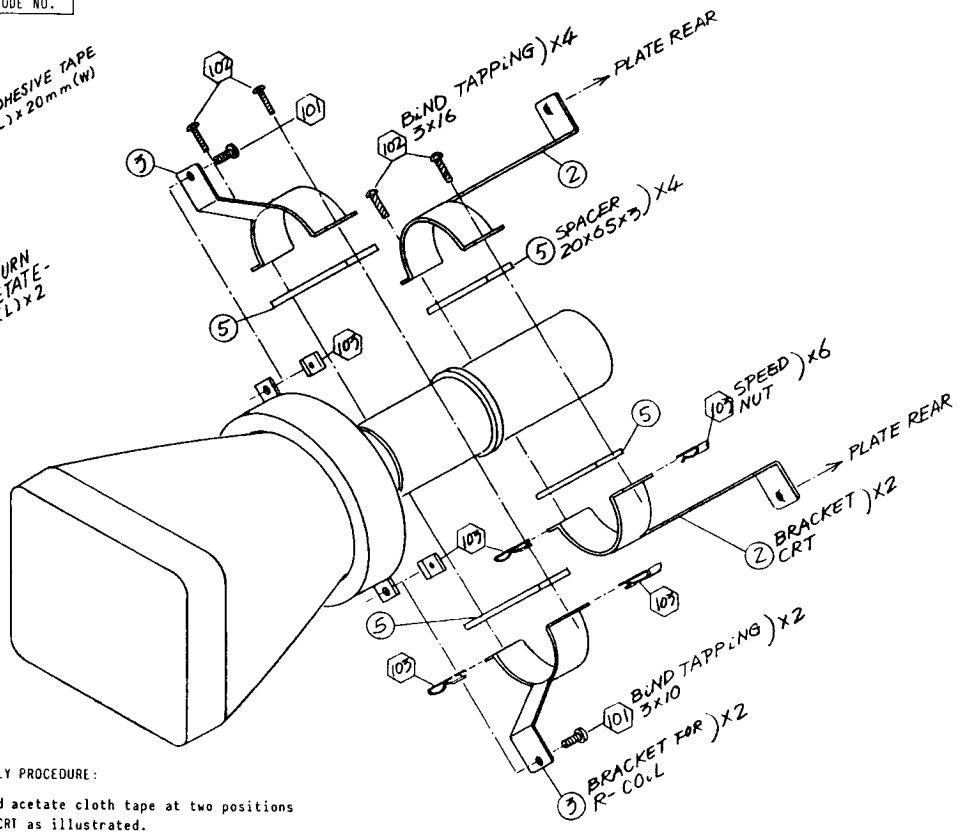
316100

12			
11			
10			
9			
8	ADHESIVE TAPE'ACETATE'571S	260mm	T4-000-131
7	ADHESIVE TAPE'ALUMI'833S	310mm	T4-000-121
6	ADHESIVE TAPE NO721 W=20	120mm	T4-000-091
5	SPACER 20 x 65 x 3	4	R3-050-051
4	SK-BINDER SKB-3	1	P4-000-571
3	BRACKET FOR R-COIL	2	D3-507-102
2	BRACKET CRT	2	D3-507-101
1	SHIELD CRT	1	C8-507-101
NO.	NAME	QTY	CODE NO.

106			
105			
104			
103	U-TYPE SPEED NUT	6	M8-000-391
102	BINDER HEAD TAPPING 3x16	4	M2-014-051
101	BINDER HEAD TAPPING 3x10	2	M2-014-031
NO.	NAME	QTY	CODE NO.







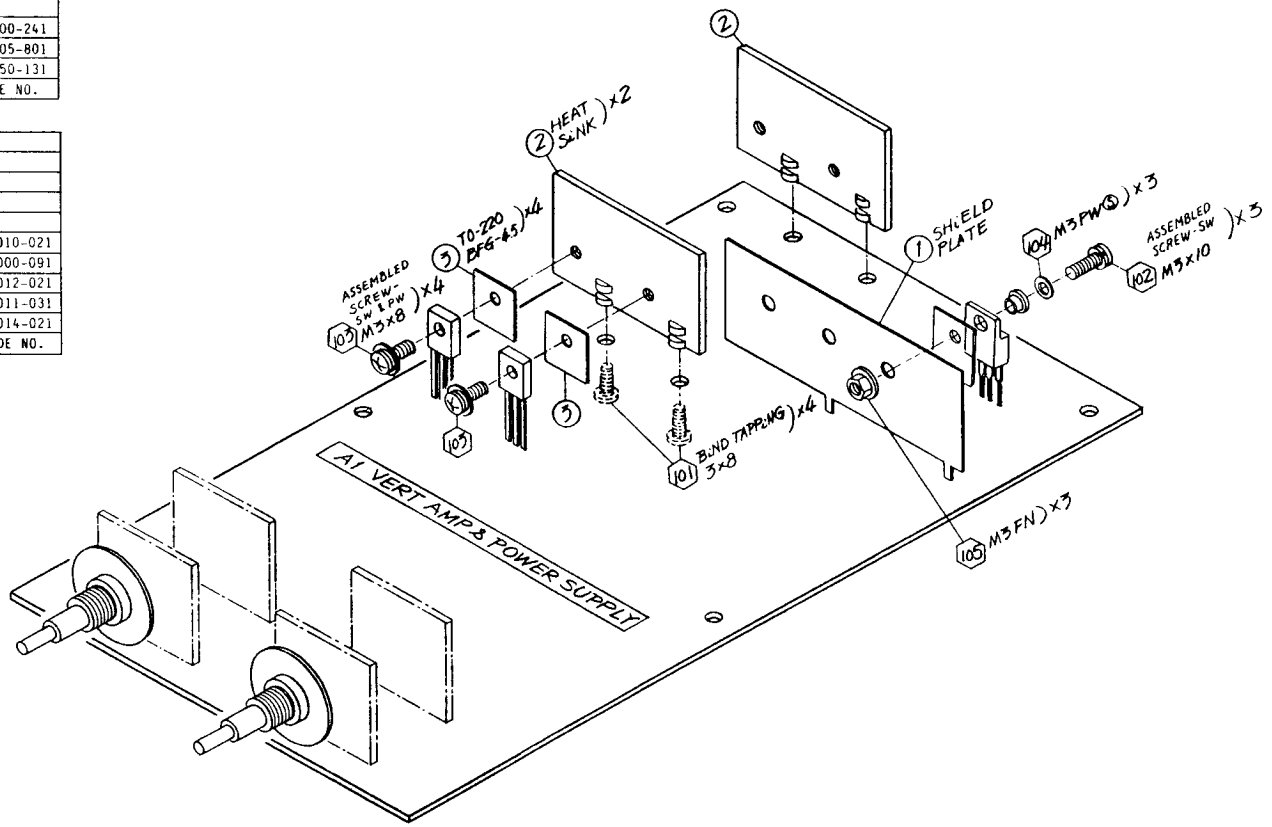
ASSEMBLY PROCEDURE:

- o Wind acetate cloth tape at two positions on CRT as illustrated.
- o Post double-faced tape as illustrated.
- o Put shield plate end on double-faced tape as illustrated, and wind shield board on CRT, exercising case so that no gaps are formed. (Wind shield plate in such position that 2 - 3 mm of acetate tape is visible from shield plate end.)
- o Clamp shield plate with SK binder as illustrated.

CRT ASSEMBLY

5			
4			
3	TO-220 D-4 BFG-45	4	X1-000-241
2	HEAT SINK	2	H1-505-801
1	SHIELD PLATE 30 × 80 × 0.3	1	C9-050-131
NO.	NAME	QTY	CODE NO.

110			
109			
108			
107			
106			
105	FLANGE NUT M3FN	3	M4-010-021
104	WASHER M3PW(S)	3	M5-000-091
103	ASSEMBLED SCREW-SW&PW M3×8	4	M3-012-021
102	ASSEMBLED SCREW-SW M3 × 10	3	M3-011-031
101	BINDER HEAD TAPPING 3×8	4	M2-014-021
NO.	NAME	QTY	CODE NO.



CIRCUIT BOARD ASSEMBLY
(VERTICAL)

5			
4			
3			
2	IC-2425-S1 HEAT SINK	1	H2-000-181
1	SHIELD BOX FOR DD-CON	1	CB-505-601
NO.	NAME	QTY	CODE NO.

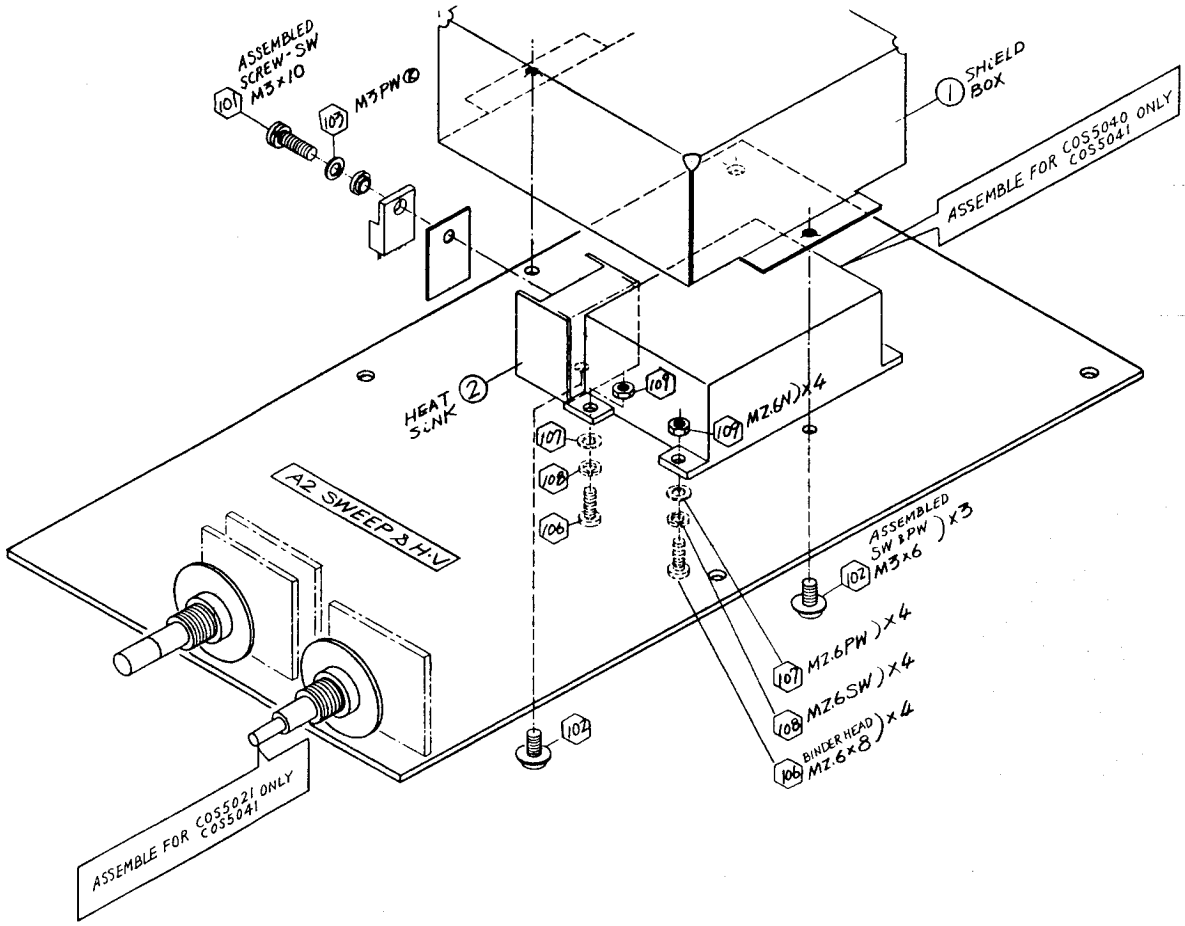
105			
104			
103	WASHER M3PW(K)	1	M5-000-091
102	ASSEMBLED SCREW-SW&PW M3×6	3	M3-012-011
101	ASSEMBLED SCREW-SW M3×10	1	M3-011-031
NO.	NAME	QTY	CODE NO.

FOR COS5040,5041 ONLY

110			
109	NUT M2.6N	4	M4-000-021
108	SPRING WASHER M2.6SW	4	M5-001-021
107	WASHER M2.6PW	4	M5-000-021
106	BINDER HEAD SCREW M2.6×8	4	M2-000-051
NO.	NAME	QTY	CODE NO.

FOR COS5040,5041 ONLY

9			
8			
7	BUSHING RUBBER BU-687EXS	1	P4-000-781
6	H.V UNIT CASE	1	P1-050-041
NO.	NAME	QTY	CODE NO.

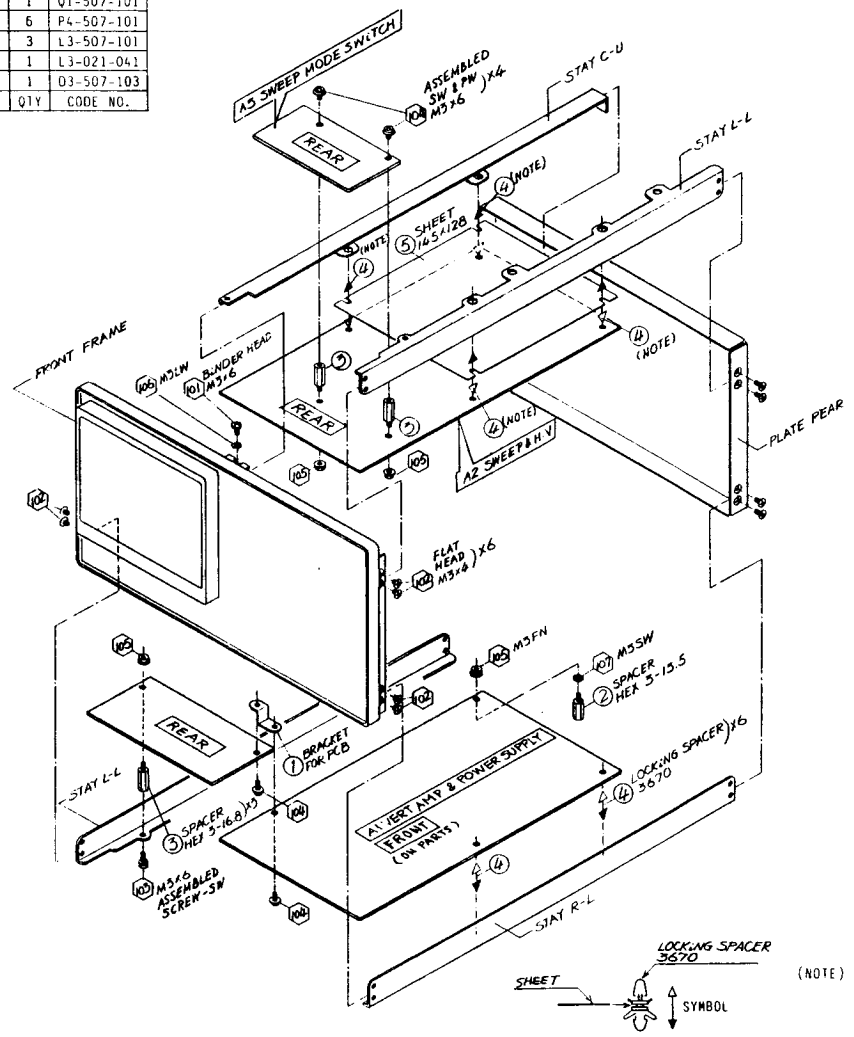


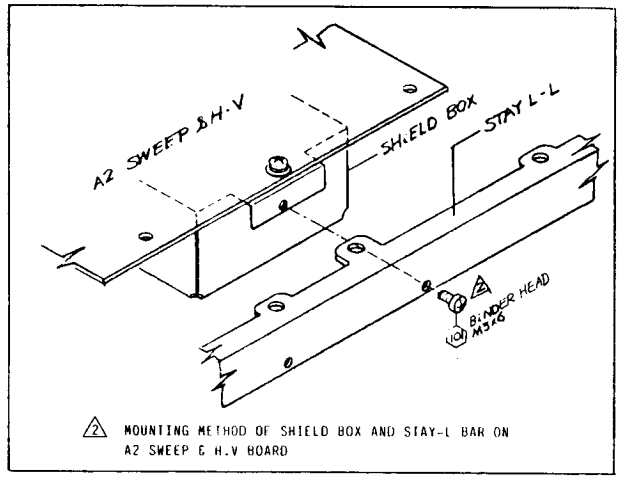
For Service Manuals Contact
MAURITRON TECHNICAL SERVICES
8 Cherry Tree Rd, Chinnor
Oxon OX9 4QY
Tel:- 01844-351694 Fax:- 01844-352554
Email:- enquiries@mauritron.co.uk

CIRCUIT BOARD ASSEMBLY
(TIME-BASE)

NO.	NAME	QTY	CODE NO.
10			
9			
8			
7			
6			
5	SHEET 145×128	1	Q1-507-101
4	NYLON LOCKING SPACER 3670	6	P4-507-101
3	SPACER HEX 3-16.8	3	L3-507-101
2	SPACER HEX 3-13.5	1	L3-021-041
1	BRACKET FOR PCB	1	03-507-103

NO.	NAME	QTY	CODE NO.
110			
109			
108			
107	SPRING WASHER M3SW	1	M5-011-031
106	LOCK WASHER M3LW	1	M5-002-041
105	FLANGE NUT M3FN	4	M4-010-021
104	ASSEMBLED SCREW-SWEPW M3×6	4	M3-012-011
103	ASSEMBLED SCREW-SW M3×6	1	M3-011-011
102	FLAT HEAD SCREW M3×4	6	M2-001-071
101	BINDER HEAD SCREW M3x6 B-NI	2	M2-000-391 ⚠2





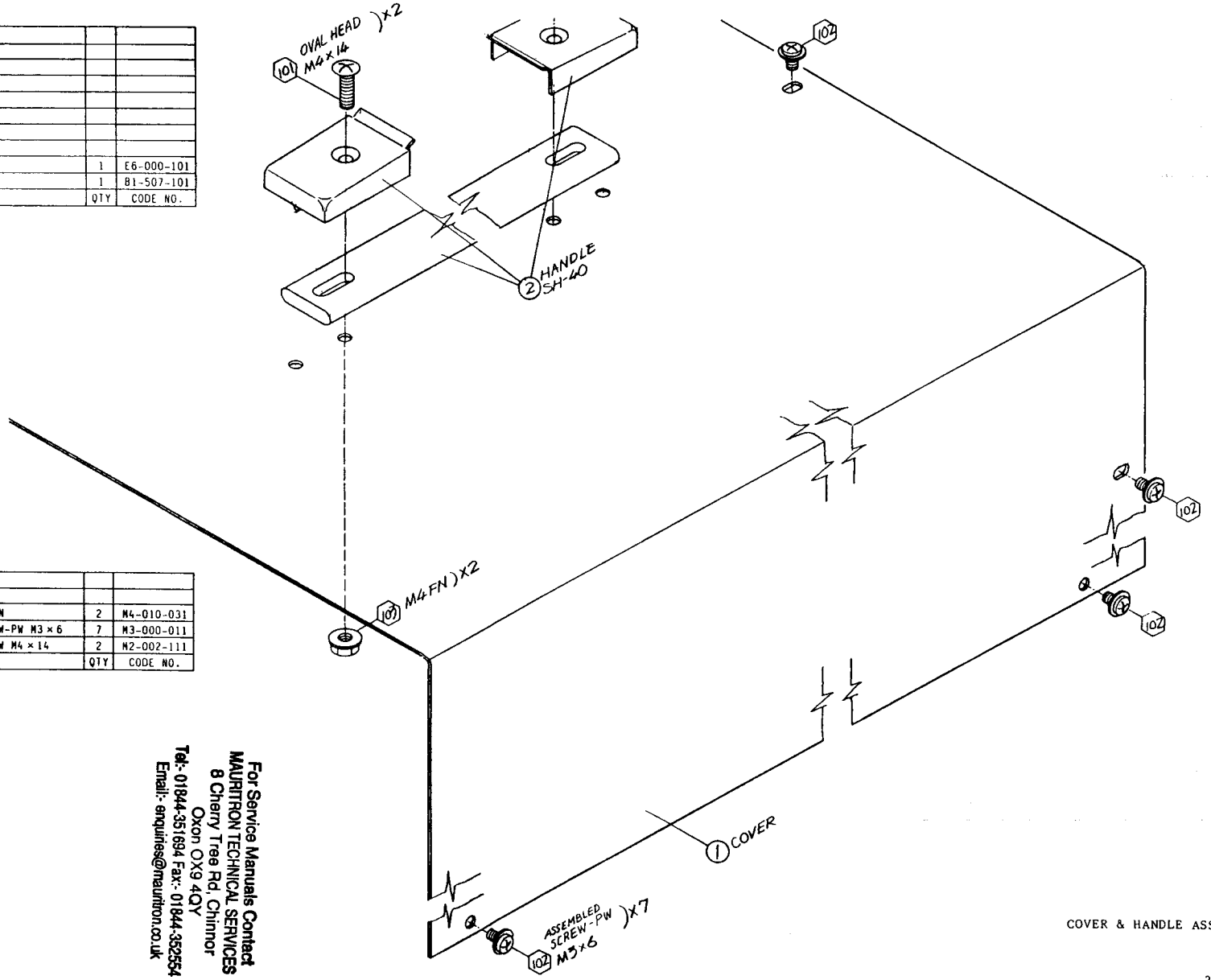
⚠2 MOUNTING METHOD OF SHIELD BOX AND STAY-L BAR ON A2 SWEEP & H.V BOARD

(NOTE) SHEET INSERTION METHOD:
Insert slit of sheet into gap at waist of locking spacer.

CIRCUIT BOARDS INSTALLATION

NO.	NAME	QTY	CODE NO.
10			
9			
8			
7			
6			
5			
4			
3			
2	HANDLE SH-40	1	E6-000-101
1	COVER	1	B1-507-101

NO.	NAME	QTY	CODE NO.
105			
104			
103	FLANGE NUT M4FN	2	M4-010-031
102	ASSEMBLED SCREW-PW M3 × 6	7	M3-000-011
101	OVAL HEAD SCREW M4 × 14	2	M2-002-111

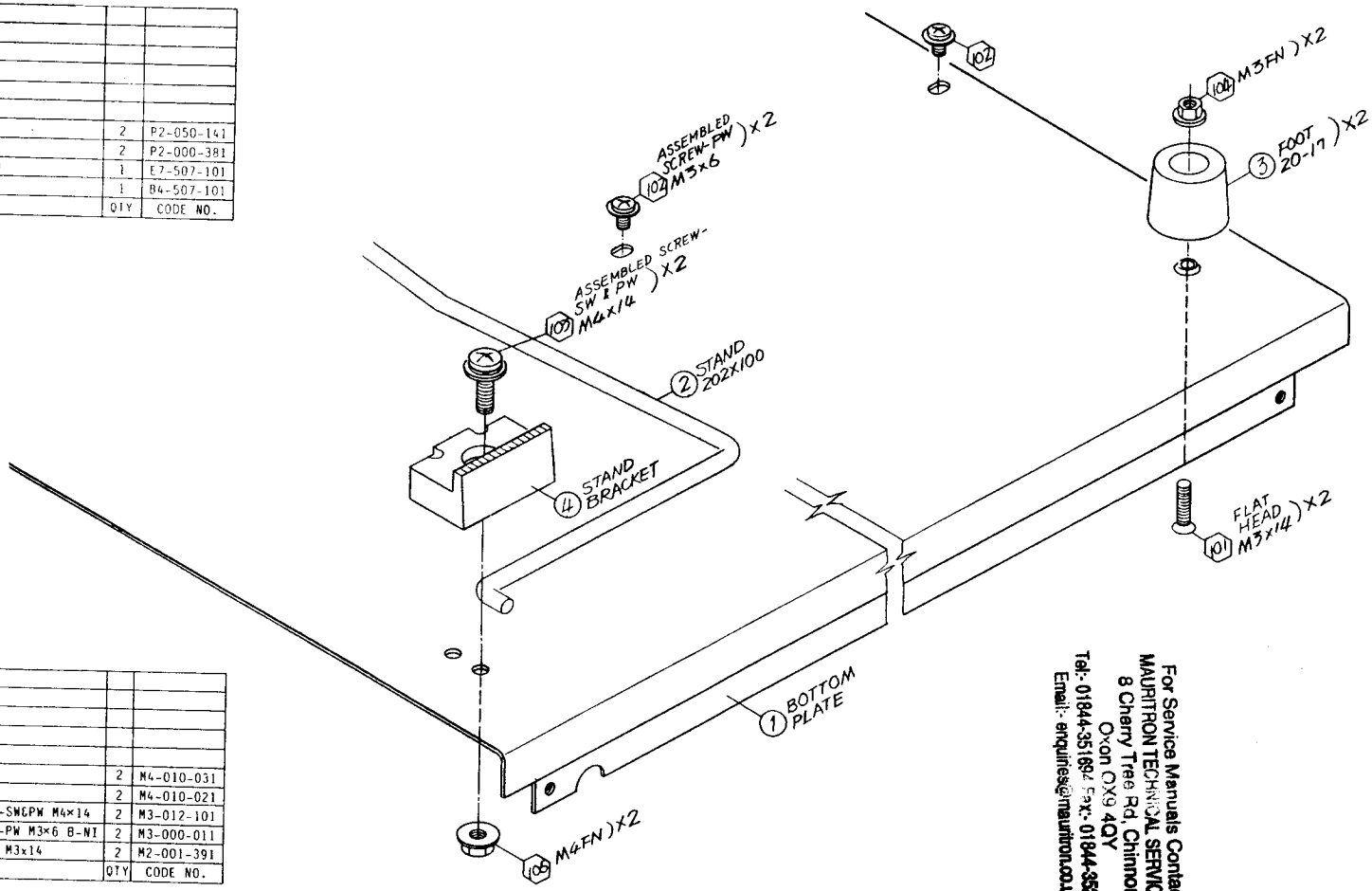


For Service Manuals Contact
MAURITRON TECHNICAL SERVICES
8 Cherry Tree Rd, Chinnor
Oxon OX9 4QY
Tel:- 01844-351694 Fax:- 01844-352554
Email:- enquiries@mauritron.co.uk

COVER & HANDLE ASSEMBLY

316109

NO.	NAME	QTY	CODE NO.
10			
9			
8			
7			
6			
5			
4	STAND BRACKET	2	P2-050-141
3	FOOT 20-17	2	P2-000-381
2	STAND 202 ×100	1	E7-507-101
1	BOTTOM PLATE	1	B4-507-101



NO.	NAME	QTY	CODE NO.
110			
109			
108			
107			
106			
105	FLANGE NUT M4FN	2	M4-010-031
104	FLANGE NUT M3FN	2	M4-010-021
103	ASSEMBLED SCREW-SWGPW M4×14	2	M3-012-101
102	ASSEMBLED SCREW-PW M3×6 B-NI	2	M3-000-011
101	FLAT HEAD SCREW M3x14	2	M2-001-391

For Service Manuals Contact
MAURITRON TECHNICAL SERVICES
8 Cherry Tree Rd, Chinnor
Oxon OX9 4QY
Tel:- 01844-351694 Fax:- 01844-352554
Email:- enquiries@mauritron.co.uk

BOTTOM PLATE ASSEMBLY